2014-1801

United States Court of Appeals for the Federal Circuit

IN RE MAGNA ELECTRONICS, INC.,

Appellant.

Appeal from the United States Patent and Trademark Office, Patent Trial and Appeal Board in Reexamination Control No. 90/011,477

BRIEF OF APPELLANT, MAGNA ELECTRONICS, INC.

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NOVEMBER 7, 2014

I. CERTIFICATE OF INTEREST

Counsel for Appellant, certifies the following:

1. The full name of every party represented by me is: MAGNA ELECTRONICS, INC.
2. The name of the real party in interest represented by me is: MAGNA ELECTRONICS, INC.
3. The name of the parent corporation and any publicly held companies that own 10 percent or more of the stock of the party or amicus curiae represented by me is: MAGNA INTERNATIONAL, INC.
4. The names of all law firms and the partners or associates that appeared for the party or now represented by me in the trial court or agency or are expected to appear in this court are:

Gardner, Linn, Burkhart & Flory, LLP: Timothy A. Flory, Terence J. Linn

November 7, 2014

/s/ Terence J. Linn

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IV. STATEMENT OF RELATED CASES

No other appeal in or from the same action in the lower court was previously before this Court or any other appellate court. The patent at issue, U.S. Patent No. 5,949,331 is not the subject of any other appeal pending before this Court.

Appellant is involved in a lawsuit pertaining to U.S. Patent No. 5,949,331:

Magna Electronics Inc. vs. Hyundai Mobis, Co. LTD. et al. (Civil Action No. 2:12-cv-11411, Eastern District of Michigan).

This case on appeal is not related to any other case known to counsel to be pending in this or any other court that will directly affect or be directly affected by this Court's decision in the pending appeal.

U.S. Patent No. 5,949,331 was the subject of an Appeal of the previous Examiner's final rejection of the claims in a first reexamination (Reexamination Control No. 90/007,520) of the '331 patent.

The patent at issue, U.S. Patent No. 5,949,331, is related to U.S. Patent No. 6,222,447, which is the subject of another appeal (Appeal No.: 14-1801) before this court, which is an appeal of the Examiner's final rejection of the claims in Reexamination Control No. 90/011,478.

V. JURISDICTIONAL STATEMENT

Subject matter jurisdiction in the Patent Trial and Appeal Board was based upon 35 U.S.C. § 134(b) (pre-AIA). This Court has jurisdiction pursuant to 35 U.S.C. § 141(b) (pre-AIA). This appeal, taken as right from the final decision of the Patent Trial and Appeal Board rendered on May 29, 2014, was timely filed pursuant to 35 U.S.C. § 142 on July 24, 2014.

VI. STATEMENT OF THE ISSUES

1. Did the Patent Trial and Appeal Board err in affirming the Examiner's rejection of claims 3 and 5-9 of U.S. Patent 5,949,331 that the combination of JP '700 and JP '889 teaches or suggests a "vehicular rearview vision system . . . wherein said image enhancement comprises a graphic overlay superimposed on the displayed image indicating distances of objects from the vehicle and wherein said graphic overlay comprises at least one horizontal mark superimposed on the displayed image," as recited in independent claim 3?
2. Did the Patent Trial and Appeal Board err in affirming the Examiner's finding that the combination of JP '700 and JP '889 teaches or suggests a "vehicular rearview vision system . . . wherein said graphic overlay comprises at least one horizontal mark superimposed on the displayed image, and wherein said at least one horizontal mark comprises a plurality of short horizontal lines superimposed on the image at regular rearward intervals," as recited in independent claim 5?
3. Did the Patent Trial and Appeal Board err in failing to reverse the Examiner's rejections of claims 3 and 5-9 and in not allowing said claims?

VII. STATEMENT OF THE CASE

This is an appeal of the Final Decision of the Patent Trial and Appeal Board rendered on May 29, 2014 (A1) with respect to claims 3 and 5-9. The Final Decision was from an appeal of the Final Office Action (A720) in the second reexamination of U.S. Patent No. 5,949,331 ("the '331 patent"). The Final Office Action dated February 2, 2012 rejected claims 3, 5-9, 11, 68, 70-74, 79, 81-115, 120 and 122-154, and Appellant appealed (A856) the Final Office Action of all the rejected claims for failing to establish any sustainable question of the patentability of the rejected claims. The Appellant's Reply Brief (A1212) dated November 30, 2012 to the Examiner's Answer Brief (A1109) of the second reexamination withdrew claims 11, 68, 70-74, 79, 81-115, 120 and 122-154 without prejudice.

VIII. STATEMENT OF THE FACTS

A. The '331 Patent

The claimed invention comprises a rear-view vision system for a vehicle. The system has at least one image capture device directed rearward of the vehicle and a display system that displays images synthesized from an output of the image capture device. The display system enhances the displayed image by visually informing the driver of what is occurring in the area surrounding the vehicle (*see* Fig. 6 below of A19). The image enhancement comprises a graphic overlay superimposed on the displayed image indicating distances of objects from the vehicle. For example, the graphic overlay may comprise at least one horizontal mark superimposed on the displayed image, or the graphic overlay may comprise a plurality of short horizontal lines superimposed on the image at regular rearward intervals.

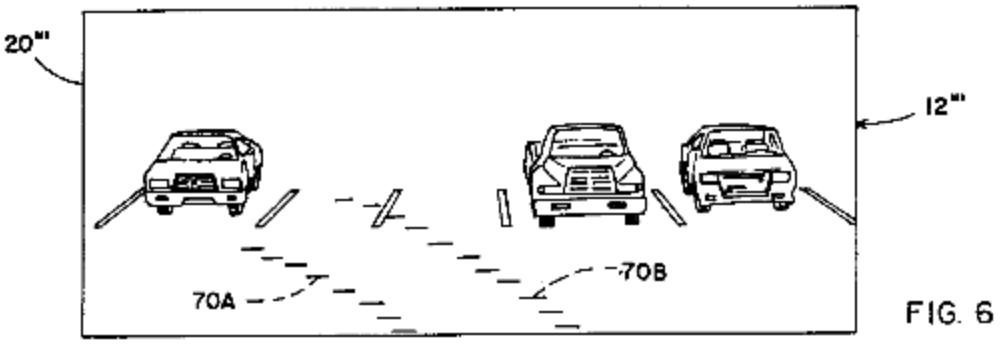


FIG. 6

B. The '331 Patent Claims at Issue

The following sets forth the limitations of each independent claim and where exemplary support for the limitations are found in the patent specification and drawings. Appellant notes that support for the claim limitations is found throughout

the '331 patent, and the portions of the '331 patent that are cited below are cited as examples of such support and the citations are not intended to be construed as citing the only support found in the patent.

Independent Claim 3 defines a vehicular rearview vision system comprising:

> at least one image capture device positioned on the vehicle and adapted to capturing images of objects (A29, 3:51-67); and
>
> a display system which displays an image which comprises a rearward facing view of objects captured by said at least one image capture device (A29. 4:1-15);
>
> wherein said display system enhances the displayed image by including an image enhancement comprising a visual prompt perspectively related to objects in the image displayed and which visually informs the driver of what is occurring in the area surrounding the vehicle including relative position of objects behind vehicle (A32, 10:18-67);
>
> wherein said image enhancement comprises a graphic overlay superimposed on the displayed image indicating distances of objects from the vehicle and wherein said graphic overlay comprises at least one horizontal mark superimposed on the displayed image (A32, 10:56-63;A19, Figure 6).

Independent Claim 5 includes the limitations of claim 3, and further comprises:

> and wherein said at least one horizontal mark comprises a plurality of short horizontal lines superimposed on the image at regular rearward intervals (A32, 10:56-63; A19, Figure 6).

C. References Applied by the Board

1. Japanese Patent Application No. 64-14700

JP '700 discloses a vehicular predicted path display device that shows a predicted path of a vehicle when the vehicle is traveling in reverse. JP '700 teaches the use of frames aligned at intervals along the predicted locus to present a perspective feeling. The predicted path display device of JP '700 displays the predicted locus when the vehicle is traveling in reverse and in response to a steering sensor that detects a turning angle of the steering wheel of the vehicle at the time of reverse travel. JP '700 thus discloses a predicted path display device that displays a predicted path of the vehicle during reverse travel and thus in response to movement of the vehicle in the reverse direction at the time of the reverse travel. A201.

2. Japanese Patent Application No. JP 60-79889

JP '889 discloses an in-vehicle television receiver that is combined with a rear view confirming television camera of the vehicle. The television receiver presents a positional relationship to a vehicle in a photographed image of the rear view confirming television camera in a screen. A262.

IX. SUMMARY OF THE ARGUMENT

This is an appeal of the Board Final Decision (A1) from the Patent Trial and Appeal Board affirming the final rejection (A720) in the second reexamination of U.S. Patent No. 5,949,331 ("the '331 patent"). The Final Office Action dated February 2, 2012 rejects claims 3, 5-9, 11, 68, 70-74, 79, 81-115, 120 and 122-154, and the Board (after the case was limited to only claims 3 and 5-9) affirmed the rejection, and Appellant appeals the Board's decision affirming the final rejection of claims 3 and 5-9. The Board decision and the final rejection failed to establish any sustainable question of the patentability of the rejected claims. As clearly indicated below, this appeal should succeed at least because none of the applied art discloses or suggests use of horizontal markings or lines in the manner claimed herein (collectively and combined with the other claimed aspects).

Appellant has shown that, regardless of what may actually be disclosed in the applied art, the applied art clearly does not disclose or suggest or render obvious the presently claimed invention. That is sufficient to overcome the rejections.

The Board did not accord sufficient or proper weight to Dr. Lynam's Declaration and the factual evidence submitted therewith. Dr. Lynam's Declaration includes factual evidence in support of the non-obviousness of the presently claimed invention. The exhibits of Dr. Lynam's declaration are part of a sworn declaration. Thus, they clearly are verified.

The Board and Examiner stated that the evidence of commercially available rear-vision camera systems does not show that the systems were commercially successful. *See* A9; A841. This is contradictory to the evidence submitted that shows that the systems in production today practice the claimed invention of the '331 patent and not the prior art. It is the production and sales of the claimed invention across several vehicle manufacturers and vehicle product lines that evidences the substantial commercial success of the claimed invention. It is the sale of the inventive rearview backup system to the automaker that constitutes the commercial success of the claimed invention. Automakers are notoriously cost conscious and have the choice for a lower price of not using graphic overlays/guidelines. Plainly, that so many vehicles across so many automakers are at dealerships today with the rear vision system and graphic overlay as claimed is clear and convincing evidence of commercial success with a straight nexus with the claim elements.

At least for these reasons, and as discussed in detail below, the rejections of the claims should be reversed.

X. ARGUMENT

A. Standard of Review

Obviousness is ultimately a legal conclusion, and this Court reviews the Patent and Trial Appeal Board's legal conclusions *de novo*. Underlying factual determinations are reviewed for substantial evidence. *Tempo Lighting, Inc. v. Tivoli, L.L.C.*, 742 F. 3d 973, 976-77 (Fed. Cir. 2014) (holding that obviousness is a question of law reviewed *de novo*).

B. No *Prima Facie* Case of Obviousness Established

The arguments submitted herewith are directed particularly towards the below claimed elements, collectively and in combination with the other claimed elements. The provision of a graphic overlay that comprises horizontal markings that are indicative of distance to objects to the rear of the vehicle in order to allow the operator to judge the relative distance to objects behind the equipped vehicle, as claimed herein. These elements, collectively and in combination with other claim elements, and how they are distinguished over and patentable over the applied art, are discussed in detail below.

As discussed in detail below, Appellant submits that the rejections and decision do not establish a *prima facie* case of obviousness at least because (a) none of the cited references (alone or in combination) disclose or suggest the combination of claimed elements that includes a graphic overlay comprising horizontal markings

or lines that are indicative of distance to objects to the rear of the vehicle in order to allow the operator to judge the relative distance to objects behind the equipped vehicle; (b) there is no suggestion or motivation either in the references themselves or in the knowledge generally available to one of ordinary skill in the art to modify the references or combine the reference teachings to arrive at the claimed invention; (c) at the time of the invention, there would not have been a reasonable expectation of success in combining the prior art references; and (d) the prior art, taken as a whole, teaches away from the claimed invention.

C. Affirming the Rejection Under 35 U.S.C. §103(a) Over Japanese Laid Open Patent Application JP 64-14700 (Hereinafter "JP '700"), in View of Japanese Laid Open Patent Application JP 60-79889 (Hereinafter "JP '889") was in Error

Appellant respectfully submits the Board erred in affirming the Examiner's rejection. JP '700, either alone or in combination with JP '889, does not disclose or suggest, or render obvious to one of ordinary skill in the art at the time of the invention, the vehicular rearview vision system of the present invention, particularly as set forth in claims 3, and 5-9.

1. Independent Claim 3

With respect to the rejection of independent claim 3, neither JP '700 nor JP '889, either alone or in combination, discloses or suggests or renders obvious a rearview vision system that has image enhancement comprising a graphic overlay superimposed on a displayed image and comprising at least one horizontal linear

mark superimposed on the displayed image, collectively and combined with the other claim elements.

Appellant respectfully submits that neither JP '700 nor JP '889 (alone or in combination) discloses or suggests providing a graphic overlay that comprises at least one horizontal mark that provides indication of distance of objects from the vehicle, such as claimed. To the contrary, JP '700 and JP '889 merely disclose providing a predicted path that provides positional awareness.

a. Knowing where the rearmost position of the equipped vehicle lies is not distance determination to a child or other object in the rearward path of maneuver of the equipped vehicle

Appellant submits that neither JP '700 nor JP '889, alone or in combination with one another and/or with other cited prior art, disclose or suggest or render obvious the claimed subject matter relating to at least one horizontal mark extending horizontally at least partially across the displayed image in order to provide an indication of distance. For example, Figures 3(a-c) of JP '700 show the predicted locus with frames (as in Figure 3(b)) aligned at intervals along the predicted locus *in order to present a perspective feeling*. Figure 3(a) merely emphasizes the rearmost portion of the *equipped* vehicle. Figure 3(c) is a vehicle body that is drawn as a box *on the basis of a locus of front and rear wheels in a certain position*. A perspective feeling is different than a distance determination. Knowing where the rearmost position of the equipped vehicle lies is not distance determination to a child or other

object in the rearward path of maneuver of the equipped vehicle. A box drawn on the basis of a predicted locus is not a distance determination. JP '700 provides a predicted locus display but does not provide or suggest an indication of distance as claimed herein. A608¶30.

b. A sense of positional relationship (for example, to the left or to the right) is distinct and different from indicating a distance

As discussed above, JP '700 teaches that the predicted path display be itself distorted to match distortions on the screen seen by the driver when using a super-wide-angle rear backup camera, and, by so distorting, the intended purpose of JP '700 is sustained (and that purpose is to provide a predicted path that "can be perceptually confirmed on the image" and to give "the driver the sense of positional relationship relative to an obstacle, thereby facilitating manipulation of the steering wheel during general parking or reverse parking"). A619¶50. However, by distorting the predicted path display to match the highly distorted video image displayed by a backup camera with a super-wide-angle lens, the predicted path display fails to operate as do the graphic overlays and in the '331 patent to reliably indicate distance behind the vehicle when reversing. A sense of positional relationship (for example, to the left or to the right) is distinct and different from indicating a distance. A619¶50.

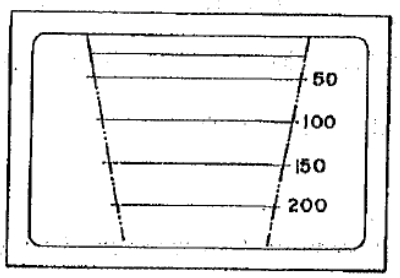
That JP '700 teaches that the predicted path display be itself distorted to match distortions on the screen seen by the driver when using a super-wide-angle rear

backup camera mitigates against it being combinable with JP '889 as suggested by the examiner without undertaking JP '700's polar coordinate conversion on the scale of JP '889. A619-20¶51. JP '889 describes its scale to represent a positional relationship, and JP '889 describes nothing about the lens or distortion seen on the camera to be used with JP '889's scale, but since the state-of-art prior to Schofield was to use the likes of JP '700's super-wide-angle rear backup camera, it is both reasonable and logical that any combination of JP '700 with JP '889 prior to Schofield would apply the polar conversion of JP '700 to JP '889's scale, and this would distort JP '889's scale as in JP '700. A619¶50. This, as in JP '700, would preserve the positional relationship of the JP '889 scale, but would not provide the indication of distance behind the vehicle such as is claimed herein. A619¶51.

The "scale" in JP ‘889 is described to be "representing the positional relationship to the vehicle." A265, 6-7. That the "scale" represents a positional relationship is repeated and reinforced. *See* A261, 8 and 18; A265, 15-16. A positional relationship (for example, to the left or to the right) is distinct and different from indicating a distance, as the dictionary definitions given in the footnotes in Dr. Lynam's Declaration attest. A620-21¶53, fns. 13 and 14; A698.

Figure 2 of JP '889 shows the "scale" of JP '889 to be:

第 2 図



One of ordinary skill in the art would take what is shown in Figure 2 to be oriented in the way that JP '889 discloses the scale to be seen in a vehicle. A621-22¶54. Thus, in Figure 2, the number "200" is closest to where one of ordinary skill in the art would take to be at the rear of the equipped vehicle and the number "50" is furthest from the rear of the equipped vehicle. JP '889 does not state what these numbers refer to but since 200 is a number four times larger than 50, it is not logical that these numbers refer to a distance indication as claimed herein. A621-22¶54.

With respect to the JP '889 reference, the Board incorrectly affirmed the Examiner's contention that Appellant's prior argument is convoluted and confusing and states (A803):

> With respect to the JP '889 reference, the argument is convoluted and confusing as the Patent owner does not make clear that the Fig. 2 in 'JP 889 represent the positional relationship of what, the objects or lines to the vehicle or object to lines.

The Examiner thus admitted that he did not understand the technical details provided, and a rejection based on his lack of understanding cannot stand. Moreover, the Board and the Examiner do not make clear what the objection is. As best understood, it appears that the Examiner required the Appellant to determine what is actually shown in Figure 2 of JP '889. Appellant respectfully submits that it is not the Appellant's responsibility to figure out what the confusing figure in the art applied by the Examiner or Board means. Appellant has met the burden of explaining how the applied art fails to disclose or suggest or render obvious the presently claimed invention. Regardless of what may actually be shown in the applied art, nothing more is needed to overcome the rejections.

c. JP '889 merely and solely states that Figure 2 is a scale representing a positional relationship to a vehicle

All JP '889 states is that (like JP '700) this "scale" represents the positional relationship to the vehicle, and JP '889 does not state or suggest that this "scale" provides an indication of distance to the vehicle. The descending scale of "200" down to "50" in Figure 2 of JP '889 confirms that this "scale" does not provide, and was not intended to provide, an indication of distance to objects to the rear of the vehicle as claimed herein. Even were it argued that the numbers on the scale somehow relate to how far away an object might be behind the vehicle, and besides this being speculation and guessing as JP '889 does not explain what such numbers mean, this would require that some form of object detection system on the vehicle

(or on the object) and then a "distance from the object back to the rear of the vehicle" calculation system be used. A621-22¶54. There is no disclsoure or suggestion of any such system in JP '889. JP '889 merely and solely states that Figure 2 is a scale representing a *positional relationship* to a vehicle.

Furthermore, JP '700 is concerned with a predicted path that, working off a steering sensor that senses the instantaneous turning angle of the vehicle, helps a driver turn the steering wheel when executing a backup maneuver into the likes of a parking slot between two parked vehicles (*see* A202).

> However, the field of vision from the position of the camera is different from the field of vision viewed from the driver seat. Therefore, it is difficult for the driver to perceptuially grasp the relationship between his or her manipulation of the vehicle and resulting vehicle action from the screen. Furthermore, watching the image while manipulating the vehicle is actually quite an arduous task due to the narrow camera angle of view.
>
> In the vehicular predicted path display device according to the present invention, an image of a rear or side rear field of vision projected by a camera is displayed. When a steering wheel is manipulated, a predicted path corresponding to an turning angle of the steering wheel is read out by an image processing device, and the predicted path is superimposed on the image of the rear or side rear field of vision. Accordingly, the predicted path can be perceptually confirmed on the image. Furthermore, including an outline of the vehicle in such a predicted path gives a dirver the sense of a positional relationship relative to an obstacle, thereby facilitating manipulation of the steering wheel during general parking or reverse parking.

Thus, in its own words, JP '700 facilitates the driver's manipulation of the steering wheel based on a postional relationship to the displayed predicted path. Thus, the driver turns the steering wheel to the right or to the left in accordance with

what the driver sees on the video screen in terms of the positional relationship (to the left? or to the right?) of the predicted path to where the driver wants to reverse. JP '889 states its scale similary represents a positional relationship. A622¶55.

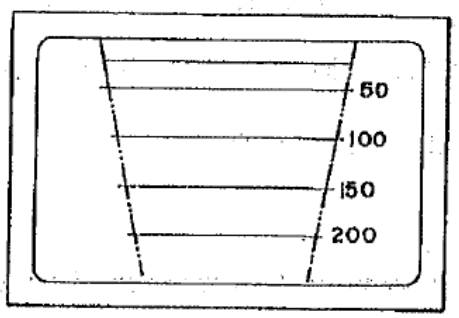
d. JP '889 discloses a scale representing positional relationship and does not disclose a distance scale

In affirming the rejection, the Board and Examiner solely rely on JP '889 for allegedly indicating distance of objects from the vehicle, as in claims 3 and 5 of the '331 patent. Appellant respectfully traverses. JP '889 does not disclose indication of distance of objects. Moreover, nowhere in the English translation of JP '889 provided is the word "distance" even mentioned. JP '889 is wholly about positional relationship of objects rearward of the vehicle and the positional relationship is distinct and different from an indication of distance. A891-896.

JP '889 discloses and claims "a scale representing the positional relationship to a vehicle in a photographed image of the rear view confirming television camera in a screen." *See* A265. JP '889 states:

> . . . an input signal from the signal generator 7 for a scale, which is synchronized by a synchronous signal separated from the video signal in the synchronization separator circuit 4, is superimposed on an input signal from the color signal processing circuit 5, and output. Thus, an image shown in Fig. 2, in which a scale representing the ***positional relationship*** to the vehicle is inserted in the photographing image of the rear view confirming television camera is displayed on the screen.

第 2 図



> Since this invention is configured as described above, the following excellent effects are produced. That is, in confirming a rear view, the television receiver of the invention may be used as a television receiver for a monitor, whereby an obstacle or the like behind the vehicle can be confirmed based on the scale representing the ***positional relationship*** to the vehicle, and it may be also used as an ordinary television receiver except when confirming a rear view, whereby a telecast image or a reproduced image can be seen without scale's hindering the screen. A265 [emphasis added].

Thus, JP '889 merely discloses "a scale representing the positional relationship to the vehicle." Claim 3 of the '331 patent does not claim such a scale. To the contrary, claim 3 clearly claims "wherein said image enhancement comprises a graphic overlay superimposed on the displayed image *indicating distances* of objects *from* the vehicle."

If one of ordinary skill in the art were to view Figure 2 of JP '889 (without first studying the disclosure of the '331 patent), clearly, one would interpret Figure 2 as showing (1) a pair of diverging lines at the rear of the vehicle and/or (2) a nonsensical grid and numbering scheme arguably with the larger numbers closer to the vehicle and thus not indicative of distance to objects to the rear of the vehicle. A901.

The "scale" is described to be "representing the positional relationship to the vehicle." A265. That the "scale" represents a positional relationship is repeated and reinforced throughout the disclosure. *See* A262, 8 and 18; A265, 15-16. However, a **positional relationship** *(for example, positioned to the left or to the right, or positioned at 50 degrees or at 200 degrees)* **is distinct and different from**

indicating a distance, as the dictionary definitions show (A891-96; A608¶30, A619-23¶¶50, 51, 53-56; fns 13 and 14) and as the exemplary real life scenarios described in the Lynam Declaration also attest. A895-96; A622-23¶¶55-56.

The Board affirmed the Examiner's assertion, when faced with the fact that the two diverging lines and nonsensical numbering scheme do not and cannot indicate distance of objects from the vehicle, that "[w]hat a person of ordinary skill in the art would understand from Fig. 2 in JP '889 is that the figure does not show the display image of the rear of the vehicle, rather it is the input to be superimposed on the display image." A1168; *see* A6-7.

Thus, the Examiner and Board argued why the number "200" in Figure 2 of JP '889 appears closer to the vehicle than the number "50" by now reading into JP '889 some (non-disclosed) re-formatting of the scale and reversing or flipping or mirror image mapping of the scale before it is displayed on the screen. In other words, the Board supported the Examiner's argument that Figure 2 of JP '889 is actually only a representation of an input, but when displayed on the display image, the displayed image and scale, but somehow not the numbers themselves, may be flipped 180 degrees. A7-8.

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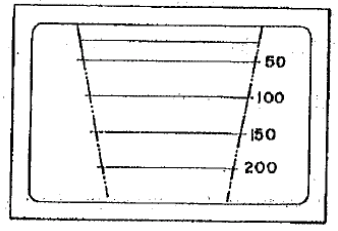
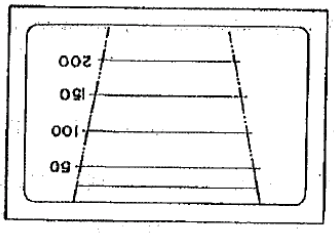


IMPROPER



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Clearly, JP '889 does *not* disclose or suggest such a transformation of its scale of Figure 2, which would require hindsight reconstruction to read JP '889 on the presently claimed invention. Such hindsight reconstruction of JP '889 in view of the '331 patent's disclosure and claims is impermissible. Indeed, the Board and the Examiner essentially stand the disclosure of JP '889 on its head and argue that what is shown above at the right is what JP '889 discloses to be what a driver of a vehicle would actually see on the display. Clearly, JP '889 does not disclose such a displayed scale.

Moreover, such an interpretation is contrary to what is actually disclosed in JP '889. The Examiner and Board completely ignores the "a scale representing the positional relationship to the vehicle is inserted in the photographing image of the rear view confirming television camera is displayed on the screen," (A265) in attempting to transform and twist the disclosure of JP '889 to match the presently claimed invention. JP '889 clearly states that the image shown in Figure 2 is displayed on the screen, and JP '889 makes no disclosure or suggestion of any transformation of the image to "properly map" the image onto the displayed image.

Further, the Examiner's interpretation, affirmed by the Board, of what the "signal generator 7" does is wholly unfounded in JP '889. JP '889 simply discloses that, when the transmission of the vehicle is not shifted into the reverse position, the input from the signal generator 7 for a scale is put in the off state, while, when the

transmission of the vehicle is shifted into the reverse position, the input signal from the signal generator 7 for a scale is in the on state and the scale is inserted in the image and is displayed on the screen. There is absolutely no disclosure in JP '889 of "mirror image mapping." Moreover, Appellant submits that the terms "mirror image" and "mapping" (which are often used by the Examiner while discussing JP '889) do not appear at all in the English translation of JP '889.

Thus, Appellant submits that such an interpretation requires reading into the applied art (particularly JP '889) a further processing and transformation of what is actually disclosed in JP '889. *See* A729, A733, A743, and A813-15. Such an interpretation of the prior art is not proper and is clearly being done using hindsight reconstruction in view of the specification and claims of the '331 patent.

Clearly, JP '889 discloses that the image shown in Figure 2 is displayed "as is" on the screen, and thus the image shown in Figure 2 of JP '889 is (if interpreted to disclose a distance scale as called out in claims 3 and 5 of the '331 patent) nonsensical, with the lines diverging and the numbers decreasing. It is simply implausible and impossible that a line marked "200" that is shown in Figure 2 of JP '889 to be closer to the rear of the vehicle than the line marked "50" could be an indication of distance from the vehicle. To suggest to a driver that a nearer line indicates a distance of "200" from the vehicle while a line farther away from the vehicle indicates a distance of "50" from the vehicle simply makes no sense.

Whatever the lines and numerals used in the scale shown in Figure 2 of JP '889 indicate, they do not indicate *distance* from the vehicle.

JP '889 provides no disclosure or suggestion as to what is meant by its term "scale," and, critically, JP '889 is all to do with *positional* relationships (and is not to do with indication of distance from a vehicle as in claims 3 and 5 of the '331 patent). The Examiner and Board attempt to interpret JP '889 as disclosing a distance scale, but such a scale, if indicating distance, is wholly nonsensical (unless twisted and transformed, such as by using "mirror image mapping" as proposed by the Examiner). *See* A7-8. Appellant does not know what JP '889 is actually attempting to disclose by its use of Figure 2 beyond what JP '889 says and shows, but submits that perhaps the "scale" of JP '889 is in degrees to assist the driver to gauge position when reversing into a parking spot.

Regardless, no matter what is actually intended to be disclosed by Figure 2 of JP '889, Appellant submits that clearly what is <u>not</u> disclosed in Figure 2 or anywhere else in JP '889 is a scale that indicates distances of objects from the vehicle, such as claimed in independent claims 3 and 5. It is not permissible to reconstruct or interpret in 2012 what one of ordinary skill in the art in the early 1990s would see and make of JP '889. If so, the skilled artisan would essentially have to stand on his or her head to "properly" insert the scale of JP '889. A1168. JP '889 says and shows what it says and shows, and what JP '889 says and shows is all to do with positional relationships

(as is JP '700). JP '889 cannot, and does not, fill in what is missing from JP '700, namely an indication of distance from a vehicle.

> **e. When manipulating the steering wheel so as to aim the vehicle so as to reverse into a vacant parking slot, the positional relationship (as in JP '700 and JP '889) is important – the driver needs to know whether to turn the steering wheel to the left or to the right. But when finally completing the parking maneuver, the driver wants to know how far the rear of the vehicle is from the likes of a wall or a barrier in a parking garage. Here, distance is what is important --- the driver no longer needs know the positional relationship (the driver will by then have ceased to turn the steering wheel and will usually simply be moving straight rearward), but the driver does want to know "can I reverse a little more without banging into that wall?"**

In stark contrast with the disclosures of JP '700 and JP '889, the present invention (such as claimed in independent claim 3) provides an indication of distances of objects from the vehicle and behind the vehicle. This is not synonymous with providing a positional relationship as in JP '700 and JP '889. Two real-world scenarios illustrate this: When manipulating the steering wheel so as to aim the vehicle so as to reverse into a vacant parking slot, the positional relationship (as in JP '700 and JP '889) is important – the driver needs to know whether to turn the steering wheel to the left or to the right. A623¶56.

But when finally completing the parking maneuver, the driver wants to know how far the rear of the vehicle is from the likes of a wall or a barrier in a parking garage. Here, distance is what is important --- the driver no longer needs know the

positional relationship (the driver will by then have ceased to turn the steering wheel and will usually simply be moving straight rearward), but the driver does want to know "can I reverse a little more without banging into that wall?" These real-world examples aptly illustrate that the positional relationship of JP '700 and JP '889 is not synonymous with the provision of an indication of distance behind the vehicle, as claimed herein, and this reinforces that one of ordinary skill in the subject art in the early 1990s would not have been motivated to combine JP '700 and JP '889 to arrive at the presently claimed invention. A623¶56. Thus, Appellant submits that the combination of JP '889 and JP '700 (alone or in further combination with other applied art) does not disclose or suggest or render obvious to one of ordinary skill in the art at the time of the Schofield invention the rearward vision system as claimed in independent claim 3.

Clearly, the combination of JP '700 and JP '889 does not render the claimed invention obvious to one of ordinary skill in the art at the time of the invention. Moreover, secondary considerations, including evidence of commercial success of the claimed invention, long felt but unsolved need in the art, teaching away from the claimed invention by the prior art, recognition of a problem to be solved by the claimed invention, licensing of the claimed invention and copying of the claimed invention by others, further augment the novelty and non-obviousness of the claimed invention of patent claim 3. A670-71; *See also KSR International Co. v. Teleflex Inc.*

et al., 550 U.S. 398 (2007), and *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1 (1966). Accordingly, Appellant respectfully submits that JP '700 and JP '889 (either alone or in combination) do not disclose or suggest the rearward vision system of the present invention, particularly as set forth in independent claim 3.

f. The Examiner misconstrued the claims

Both independent claims 3 and 5 include the following limitation:

> wherein said image enhancement comprises **a graphic overlay** superimposed on the displayed image **indicating distances of objects <u>from</u> the vehicle** and wherein said graphic overlay comprises at least one horizontal mark superimposed on the displayed image (emphasis added).

The Examiner and Board state that the horizontal markings of the '331 patent provide indication of distance and that provide the driver indication or judgment of relative distance of objects *to* the vehicle. A1164-65; A7-8. However, Appellant submits that the horizontal markings of the '331 patent (as claimed in claims 3 and 5-9) provide indication of distance and provide the driver indication or judgment of relative distance of objects <u>from</u> the vehicle.

As detailed further below, the significance of the Examiner's "to" and Appellant's "from" becomes clear and significant in light of what JP '889 actually discloses. The Examiner stated:

> the claim language is clear that first the driver by looking at the grid markings, judges the relative position of the rearmost of the car and then judges the relative distance of objects by comparing to the horizontal marks showing the rearmost position of the vehicle. This determination of distance of markings to the rear of the vehicle, which

> results in determination of relative position of objects behind the vehicle, provides an indication of distances of objects ("indicating distances of objects," in claim 3). A1164 (emphasis in original); *see also* A6-7.

In contrast, Appellant submits that the claim language is clear that first, the driver, by looking at the grid markings, judges the relative position of the rearmost of the vehicle and then judges the relative distance of objects by comparing to the horizontal marks showing the rearmost position of the vehicle. This determination of distance of markings from the rear of the vehicle, which results in determination of relative position of objects behind the vehicle, provides an indication of distances of objects from the vehicle.

2. Independent Claim 5

With respect to the rejection of independent claim 5, claim 5 includes the limitation that the at least one horizontal mark comprises a plurality of short horizontal lines superimposed on the image at regular rearward intervals.

The Examiner merely stated (A730):

> [5.2a] wherein said image enhancement comprises a graphic overlay superimposed on the image indicating distances of objects from the vehicle and wherein said graphic overlay comprises and least one horizontal line.
>
> See [3.2a] above

But this is not what is claimed in claim 5, and the Board incorrectly describes the difference as "design choice." A8. Independent claim 5 clearly states that the at

least one horizontal mark comprises a plurality of ***short horizontal lines*** superimposed on the image at regular rearward intervals. Appellant submits that neither JP '700 nor JP '889 discloses a vehicular vision system that provides a graphic overlay that comprises a plurality of short horizontal lines superimposed on the image at regular rearward intervals, collectively and in combination with the other claim elements. Moreover, the Decision failed to fully address this limitation in affirming the rejection of claim 5 and, thus, has fallen well short of the requirements of establishing a *prima facie* case of obviousness of independent claim 5.

a. Horizontal lines have contributed to the commercial success of commercial camera-based back-up systems with such graphic overlays

Appellant submits that neither JP '700 nor JP '889 (alone or in combination) discloses or suggests the claimed rearview vision system for the reasons set forth above, and does not disclose or suggest such a rearview vision system with the horizontal markings comprising horizontal lines. The use of such horizontal lines, and collectively and combined together with the other aspects of the claimed invention, has contributed to the enhanced performance of the system of the present invention and the commercial success of commercial camera-based back-up systems with such graphic overlays, as evidenced by the fact that vehicles at dealerships today include the likes of horizontal linear marks of the Schofield et al. invention, and not the predicted locus frames of JP '700.

The use of such horizontal lines, such as short horizontal lines spaced laterally apart on the displayed image (*see* A24 Fig. 6), collectively and combined together with the other aspects of the claimed invention, has contributed to the enhanced performance of the system of the present invention. A604¶18 and A631-32¶77.

The regularly spaced short horizontal lines or grid markings of the '331 patent are important to the commercial success of the rearview vision system disclosed and claimed in the '331 patent. The horizontal lines extend at least partially across the displayed image and are superimposed on the image at regular rearward intervals, and allow the driver to readily judge the distance to displayed objects that are rearward of the vehicle, even to objects that are not along the path of the superimposed regularly spaced horizontal lines. Because the horizontal lines are superimposed on the image at regular rearward intervals, not only do the horizontal lines allow the driver to readily judge distances, but the regularly spaced horizontal lines provide a reliable judgment of or indication of distances to objects rearward of the vehicle.

Reversing can be a complicated and confusing maneuver, and the innovative provision of horizontal lines as taught in Schofield '331 allows the driver to readily and reliably determine whether to begin to move, cease moving or continue moving. The widespread use of Schofield's teachings and claimed subject matter evidences the novelty of what is disclosed in the '331 patent. Clearly, JP '700 nor JP '889, either

alone or in combination with one another or with other cited art, does not disclose or suggest or render obvious to one of ordinary skill in the art the combination of features that collectively and combined together constitute the claimed subject matter of the rearview vision system of the claimed invention, particularly as set forth in independent claim 5 and for at least the reasons set forth above.

Clearly, the combination of JP '700 and JP '889 does not render the claimed invention obvious to one of ordinary skill in the art at the time of the invention. Moreover, secondary considerations, including evidence of commercial success of the claimed invention, long felt but unsolved need in the art, teaching away from the claimed invention by the prior art, recognition of a problem to be solved by the claimed invention, licensing of the claimed invention and copying of the claimed invention by others, further augment the novelty and non-obviousness of the claimed invention of patent claim 5. A670-71; *see also KSR International Co. v. Teleflex Inc. et al.*, 550 U.S. 398 (2007), and *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1 (1966).

Thus, the combination of JP '700 and JP '889 does not disclose or suggest or render obvious to one of ordinary skill in the art the combination of features that collectively and combined together constitute the claimed subject matter of the rearview vision system of the claimed invention, particularly as set forth in claim 5. Accordingly, Appellant respectfully submits that JP '700 and JP '889 do not disclose

or suggest the rearward vision system of the present invention, particularly as set forth in independent claim 5.

3. Dependent Claims 6-9

With reference to the rejection of dependent claims 6 (lines are positioned to correspond to boundaries of the lane in which the vehicle is travelling), 7 (lines are moved laterally to correspond to positions of curved lane boundaries when the vehicle is turning), 8 (including a monitoring device for monitoring vehicles turning) and 9 (said monitoring device comprises one of a monitor of movement of the vehicle's steering system, a monitor of an output of an electronic compass, and a monitor of the vehicle's differential drive system), Appellant submits that these claims are patentable over the cited art of record for the reasons set forth above.

D. Secondary Considerations and Objective Evidence of Non-Obviousness

Although Appellant submits that the Office Action and the Decision failed to produce a *prima facie* case of obviousness of the claimed invention, Appellant further submits substantial objective evidence in conjunction with this response that clearly evidences the non-obviousness of the claimed invention of the '331 patent. Despite the Board brushing off the presented evidence (*see* A9-10), the evidence includes long felt need and failure of others, the skepticism of experts, unexpected results, copying, commercial success, and licensing. Such objective evidence or secondary considerations are relevant to the issue of obviousness. *See Graham*, 383 U.S. at 17-18; and *KSR*, 550 U.S. 398; *See also Süd Chemie, Inc. v. Multisorb*

Technologies, Inc., 554 F.3d 1001, 1008 (Fed. Cir. 2009) ("As we have repeatedly emphasized, evidence relating to secondary considerations 'constitutes independent evidence of nonobviousness' and can be quite instructive in the obviousness inquiry."), citing *Ortho-McNeil Pharm., Inc. v. Mylan Labs., Inc.*, 520 F.3d 1358, 1365 (Fed. Cir. 2008).

1. Long Felt Need and Failure of Others

Appellant submits that, prior to the Schofield invention, rearward vision systems for vehicles utilized CCD cameras or television cameras. Dr. Lynam was, at the time of the Schofield invention, at least one of ordinary skill in the art, and is thus qualified to opine and attest as to the state of the art at the time of the Schofield invention and the novelty of the Schofield invention. A600-01¶7. For example, at the time of the Schofield et al. invention, the three inventors of the '331 patent (Schofield, Larson and Vadas) and Dr. Lynam were employed by Donnelly Corporation, and Dr. Lynam worked with all three inventors before, during and after the time of the Schofield invention, and Dr. Lynam was present at Donnelly and had direct first-hand experience of and exposure to the research and development work that led to the filing of the application that led to the '331 patent. A600¶7.

Dr. Lynam also had first-hand experience of and exposure to the relevant state of the art before, during and after the time of the Schofield invention as such would have reasonably been known to a person of ordinary skill in the art relevant to this

present reexamination. In his declaration, Dr. Lynam indicates that for years leading up to the early 1990s, the automotive industry had long-sought an economical and effective camera-based backup system, and that this need was met by Schofield and is now deployed on the likes of many vehicles. A605¶¶23, 25; A636¶85; A667-69, A684.

2. Copying

Appellant also submits that several competitors have copied the claimed invention of the '331 patent and, in an attempt to freely use the claimed invention (the same invention that the third party requester did not even request reexamination of in the first reexamination of the '331 patent), the third party requester now requests a second reexamination of the '331 patent. Evidence shows photographs of various rearward vision systems that copy claimed inventions of the '331 patent. *See* A641, A648, A684, and A699.

Furthermore, the "Examiner noted that there is no copying". A841. Appellant traverses. How can the Examiner and the Board know this in view of the factual evidence provided? The factual evidence includes evidence of prior development of the product and access to the inventive product by others, and further includes evidence that shows that the commercial products on the road today are substantial replicates of products made in accordance with the present invention.

> "[C]opying requires the replication of a specific product. This may be demonstrated either through internal documents . . . ; direct

> evidence such as disassembling a patented prototype, photographing its features, and using the photograph as a blueprint to build a virtually identical replica . . . ; or access to, and substantial similarity to, the patented product (as opposed to the patent)".

Iron Grip Barbell Co., Inc. v. USA Sports, Inc., 392 F.3d 1317, 1325 (Fed. Cir. 2004) (internal case cites omitted). In this case, there is no doubt that the third party copiers had access to the products manufactured in accordance with the claimed invention, since these products were initially developed by Appellant, and were incorporated in commercially available vehicles on the road.

There are a relatively small number of automakers (often in the industry referred to as Original Equipment Manufacturers or "OEMs"), and there is an even smaller supply base for vehicles, and in particular, for vehicular rear backup cameras, and this supply base is highly competitive. A634-35¶81. The respective competitors closely monitor each other's products and technologies, and reverse engineering and competitive benchmarking are commonplace. The program life of a vehicle model is about 5 to 7 years or thereabouts, and about 1 to 2 years or thereabouts before a new vehicle model is to be introduced, the automaker solicits bids from its supply base (as indicated above, typically a handful of competing suppliers). There is thus only limited opportunity to bid for programs as requests from automakers to bid come along typically only when new models are being planned at OEMs. Performance to OEMs expectations includes that the part supplied

will be reliable throughout its lifetime of usage on the vehicle through all seasons and climates year after year.

The OEM automaker does not want to experience warranty returns, most definitely does not want to experience product recalls or product liabilities, wants the owner of the vehicle to be satisfied with the performance/quality, and wants the supplied part to help the OEM compete against other automakers when it comes to vehicle purchase at dealerships. In terms of business awards by automakers, advertising or the like does not play a role in winning business at automakers. A634-35¶81. Donnelly's introduction and promotion of vision systems for use on automobiles was seen to be pioneering, and other automakers (and especially Japanese automakers) waited for some years for the backup cameras to prove reliable on vehicles by being so proven by real-life usage in the field through all seasons and climates. A635¶82.

That others now scramble to copy what Schofield pioneered is evident from the market data given above showing that usage of automotive imager sensors is growing to dominate the market. Such automotive cameras already constitute a significant market share, as evidenced herein. A636-37¶88.

There can be no legitimate question that the vision systems of Lynam Exhibit C include claimed elements, nor can there be any legitimate question that a nexus exists between the merits of the claimed invention and the evidence of copying.

MPEP 716.01(b); *See also Ashland Oil, Inc. v. Delta Resins & Refractories, Inc.*, 776 F.2d 281, 305 n.42 (Fed. Cir. 1985), cert. denied, 475 U.S. 1017 (1986).

3. Commercial Success

Commercial success is presumed when a patentee can demonstrate that there are significant sales in a relevant market and that the successful product is the invention disclosed and claimed in the patent. *Ormco Corp. v. Align Technology Inc.*, 463 F. 3d 1299, 1311-12 (Fed. Cir. 2006). (As we explained in *J.T. Eaton & Co. v. Atlantic Paste & Glue Co.*, 106 F.3d 1563 (Fed. Cir. 1997), '[w]hen a patentee can demonstrate commercial success, usually shown by significant sales in a relevant market, and that the successful product is the invention disclosed and claimed in the patent, it is presumed that the commercial success is due to the patented invention.' *Id*. at 1571; see also *Brown & Williamson*, 229 F.3d at 1130 (stating the presumption that commercial success is due to the patented invention applies 'if the marketed product embodies the claimed features, and is coextensive with them.')).The commercial success of the vision systems manufactured in accordance with the claimed invention of the '331 patent is directly derived from the invention claimed.

The Examiner stated that the evidence of commercially available rear-vision camera systems does not show that the systems were commercially successful. A841. However, this is contradictory to the evidence submitted that shows that the systems in production today practice the claimed invention of the '331 patent and

not the prior art. Appellant submits that it is the production and sales of the claimed invention across several vehicle manufacturers and vehicle product lines that evidences the substantial commercial success of the claimed invention. Automakers are notoriously cost conscious and have the choice for a lower price of not using graphic overlays/guidelines and other elements of the claimed invention. Plainly, that so many vehicles across so many automakers are at dealerships today with the rear vision system and graphic overlay and other features as claimed is clear and convincing evidence of commercial success with a straight nexus with the claim elements.

Evidence shows the presently claimed invention is the subject of vision systems in production today across several vehicle manufacturers and several vehicle product lines or models. If the claimed invention were not commercially successful, then vehicle manufacturers would include vision systems that do not incorporate the claimed invention. But instead, vehicle manufacturers include vision systems made in accordance with the claimed invention of the '331 patent.

To take an illustrative example, 100 percent of the rear backup cameras used by Ford Motor Company in North America are supplied by Appellant. A635¶83. In calendar year 2010, Appellant shipped approximately 505,000 rear backup cameras to Ford, all with graphic overlays that comport with the '331 patent, all with optical correction for image distortion and many with electronic correction for image

distortion. Ford Motor Co. vehicle production in 2010 is reported to be around 2.3M vehicles, and overall, Appellant shipped around 765,000 backup cameras in 2010, representing an about 35 percent market share for rearview vision systems produced in North America in 2010. This represents a substantial quantity in the North American market for such rearview vision systems. A635¶83.

Ford and other OEMS desired to have from Appellant the proven performance of what is taught and claimed by Schofield (and not merely some increasing popularity of a particular vehicle model or the effectiveness of the marketing efforts employed) that drove Appellant's commercial success in winning such a large commercial market share. A635-36¶84. There is a clear nexus between the claimed subject-matter of the '331 patent, including the likes of use of particular types of graphic overlays, and the commercial success Appellant has had with products based on what is disclosed and claimed in the '331 patent.

As indicated above, OEMs have choice in what they buy and are price conscious and OEMs will only add the features such as are included in what Appellant sells and ships to them based on performance and on what such features do. The likes of advertising and the like play little to no role in winning a purchase order from an OEM for a rear backup camera. It was because Ford wanted what is included in Appellant's cameras that Ford placed its purchase orders with Appellant,

and what Ford wanted included use of those types of graphic overlays with distance indication as taught and claimed in the '331 patent. A635-36¶84.

The commercial success of Schofield's vehicle vision systems is thus unassailable. An element of that success is the third party copying of the '331 patent rearward vision system, such as discussed above.

Appellant has offered proof that the sales made by the third parties were a direct result of the unique characteristics of the claimed '331 patent invention - as opposed to other economic and commercial factors unrelated to the quality of the patented subject matter. *In re DBC*, 545 F. 3d 1373, 1384 (Fed Cir. 2008) (stating "the proponent must offer proof 'that the sales were a direct result of the unique characteristics of the claimed invention - as opposed to other economic and commercial factors unrelated to the quality of the patented subject matter.') *In re Huang*, 100 F.3d 135, 140 (Fed. Cir. 1996); *see also In re GPAC Inc.*, 57 F.3d 1573, 1580 (Fed. Cir. 1995) (For objective evidence to be accorded substantial weight, its proponent must establish a nexus between the evidence and the merits of the claimed invention.')."') Appellant also respectfully submits that the evidence presented in the incorporated Lynam Declaration and Lynam Exhibits does far more than merely submit evidence of sales. The driving force behind those sales is clearly evidenced herein, and is reinforced by the copying undertaken by third parties to secure the vehicle orders. The nexus between the merits of the '331 patent and third party vision

system sales is clear and compelling. Dr. Lynam's Declaration factually attests to what he knew and did as of the early 1990s, and is supported with objective evidence and is not a conclusory opinion, and is replete with factual evidence.

4. Licensing of Others

As Dr. Lynam attests in his declaration, a major OEM requested and was granted a license to the '331 patent so that that OEM could access such claims. A637¶89.

5. Secondary Considerations Thus Indicate Non-Obviousness of the Claimed Invention

Accordingly, Appellant submits that the record is replete with compelling objective evidence of non-obviousness of the claimed invention of the '331 patent. Clearly, such evidence, including evidence of long felt need and failure of others, skepticism of experts, unexpected results, copying, commercial success, and licensing, is highly relevant to the issue of obviousness.

Thus, Appellant submits that features of the claims, such as those features discussed above, escaped the prior artisans, such as the prior artisans in 1983 working on the JP '889 disclosure and in 1987 working on the JP '700 disclosure. The evidence presented herein shows that one of ordinary skill in the art could not have arrived by known methods at the combination of features that collectively and combined together constitute the claimed invention as set forth herein, and this is evidenced by the incorporation of the presently claimed features, and not those of JP

'889 or JP '700, into the likes of the camera-based back-up systems on production vehicles today. Moreover, given that prior artisans tried and failed in 1983 and 1987, the commercial and unique success of the presently claimed elements itself constitutes an unexpected result. Thus, Appellant submits that JP '700 and JP '889, in combination with the knowledge of one of ordinary skill in the art at the time of the invention of the '331 patent, lack a teaching or suggestion that would have led one of ordinary skill in the art to modify these references to arrive at the combination of features that collectively and combined together constitute the claimed invention of the claims set forth herein.

Further, Appellant submits that the inventions claimed in the '331 patent is the result of extensive experimentation and testing by the inventors to develop the '331 patent. As of the early 1990s, camera-based rearview vision systems for vehicles had not obtained commercial acceptance on the likes of the vehicles illustrated in the drawings, and camera systems then known failed to provide to the driver important information where the information is most needed – at small separation distances from the surrounding objects. *See* A28, 1:14 – 2:20.

Moreover, the teachings and claimed subject matter of the '331 patent have been important to the commercial success of such camera-based back-up systems with graphic overlays, as evidenced by the fact that vehicles at dealerships today function in the manner taught by Schofield and not in the manner taught by JP '889

or JP '700. *See* A660-63, A667-70; A685-95. Schofield's innovation of a rearward vision system and providing a graphic overlay that is indicative of a distance to an object rearward of the vehicle, while having the graphic overlay superimpose, upon moving the gear selector device to the "R" position, but with the vehicle yet to move in reverse, provides an inexpensive and effective solution to a longstanding problem.

JP '889 and JP '700 and the other prior artisans failed to see or solve the problems solved by the '331 patent, such as providing a graphic overlay to help guide a safe rearward maneuver from an initial stationary position of the vehicle, collectively and in combination with the other claimed features. Utilizing the claimed invention of the '331 patent, a driver, immediately upon moving the gear selector to select a reverse gear position, is presented with the graphic overlay and can readily judge, such as by utilizing the horizontal lines of the graphic overlay, distance to a rear positioned object or child before the vehicle moves at all. This aspect of the claimed invention of the '331 patent is now widely used on production vehicles, and to Appellant's knowledge, the systems as taught by the likes of JP '889 and JP '700 have not achieved any commercial success. A607¶28, A621-22¶54.

Thus, Appellant submits that features of the claims herein, such as those features discussed above, escaped the prior artisans, such as the prior artisans in 1982 and in 1987 working on the JP '700 and JP '889 disclosures.

XI. CONCLUSION AND STATEMENT OF RELIEF SOUGHT

For at least the reasons set forth above, and as is apparent from examining the invention defined by the claims of the '331 patent when properly considering the cited references, these claims define patentable subject matter. Accordingly, Appellant respectfully submits that all of the claims at issue herein are patentable over the prior art references of record, and reversal of the rejections of these claims under 35 U.S.C. §103 is appropriate and is respectfully solicited.

November 7, 2014

/s/ Terence J. Linn

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XII. ADDENDUM

UNITED STATES PATENT AND TRADEMARK OFFICE

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

PTOL-90A (Rev. 04/07)

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte MAGNA ELECTRONICS, INC.

Appeal 2013-006429
Reexamination Control No. 90/011,477
Patent 5,949,331
Technology Center 3900

Before HOWARD B. BLANKENSHIP, KEVIN F. TURNER, DAVID M. KOHUT, and STANLEY M. WEINBERG, *Administrative Patent Judges.*

KOHUT, *Administrative Patent Judge.*

DECISION ON APPEAL

This is an appeal under 35 U.S.C. § 134(b) from the Examiner's rejection of claims 3 and 5-9[1] of Patent 5,949,331 (hereinafter "'331 Patent"). Final Office Action mailed February 2, 2012 (hereinafter "Final Action."). An oral hearing was conducted with the Patent Owner on July 31, 2013.

We have jurisdiction under 35 U.S.C. § 306.

We AFFIRM.

STATEMENT OF THE CASE

This *ex parte* reexamination proceeding was initiated by a "REQUEST FOR REEXAMINATION" filed on February 7, 2011, by Third-Party Requester, William Mandir.

The '331 patent describes a vehicular review vision system.

Claim 5 is illustrative of the invention and reads as follows:

> 5. A vehicular rearview vision system, comprising:
> at least one image capture device positioned on the vehicle and adapted to capturing images of objects;
> a display system which displays an image which comprises a rearward facing view of objects captured by said at least one image capture device;
> wherein said display system enhances the displayed image by including an image enhancement comprising a visual prompt perspectively related to objects in the image displayed and which visually informs the driver of what is occurring in the area

[1] Appellant withdraws claims 11, 68, 70-74, 79, 81-115, 120, and 122-154 from consideration and asks the Examiner to cancel the claims without prejudice. Reply Br. 2. As such, we will not address any arguments directed toward these claims and also urge the Examiner to cancel the claims.

> surrounding the vehicle including relative position of objects behind the vehicle; and
>
> wherein said image enhancement comprises a graphic overlay superimposed on the displayed image indicating distances of objects from the vehicle and wherein said graphic overlay comprises at least one horizontal mark superimposed on the displayed image, and wherein said at least one horizontal mark comprises a plurality of short horizontal lines superimposed on the image at regular rearward intervals.

Requester proposes rejections of the claims over the following prior art references:

Matsushita Electric Co.	JP 60-79889	Oct. 23, 1986
Aisin AW Co.	JP 64-14700	Jan. 18, 1989

Appellant/Patent Owner appeals the Examiner's adoption of the following rejection:

Claims 3 and 5-9[2] are rejected under 35 U.S.C. § 103(a) as obvious over the combination of JP 64-14700 (hereinafter referred to as JP '700) and JP 60-79889 (hereinafter referred to as JP '889). Ans. 3.

ISSUES

Did the Examiner err in finding that the combination of JP '700 and JP '889 teaches or suggests a "vehicular rearview vision system . . . wherein said image enhancement comprises a graphic overlay superimposed on the displayed image indicating distances of objects from the vehicle and wherein

[2] Since Appellant withdrew claims 11, 68, 70-74, 79, 81-115, 120, and 122-154 (Reply Br. 2) we have removed them from the rejection statement.

said graphic overlay comprises at least one horizontal mark superimposed on the displayed image," as recited in independent claim 3?

Did the Examiner err in finding that the combination of JP '700 and JP '889 teaches or suggests a "vehicular rearview vision system . . . wherein said graphic overlay comprises at least one horizontal mark superimposed on the displayed image, and wherein said at least one horizontal mark comprises a plurality of short horizontal lines superimposed on the image at regular rearward intervals," as recited in independent claim 5?

Did the Examiner err in combining JP '700 and JP '889?

ANALYSIS

Claim 3

Claim 3 recites "[a] vehicular rearview vision system . . . wherein said image enhancement comprises a graphic overlay superimposed on the displayed image indicating distances of objects from the vehicle and wherein said graphic overlay comprises at least one horizontal mark superimposed on the displayed image." The Examiner adopted the Requester's proposed rejection of claim 3 over the combination of JP '700 and JP'889. Ans. 3 citing Final Office Action mailed February 2, 2012. Patent Owner argues that neither of the references, alone or in combination, teaches the disputed limitation. App. Br. 35. Patent Owner's arguments revolve around the contention that the references teach predicting the path of a vehicle which only provides positional awareness and a perspective feeling, not the distance of objects from the vehicle. App. Br. 35-38. We disagree with Patent Owner for the reasons discussed below.

We note that as indicated by the Examiner (Ans. 3), the claim does not require a distance measurement or a distance determination. Instead, the claim requires there be a display that indicates distance from objects in some manner. The explicit manner in which the distance is indicated is not particularly claimed. The Examiner cites to a portion of Patent Owner's Specification to show what was meant by the claim language. Ans. 4. In particular, the Examiner cites to column 10, lines 56-63 of the '331 patent that indicates horizontal lines spaced at intervals behind the vehicle can be used to show distances. Ans. 4. We agree with the Examiner.

Patent Owner admits that Figure 3b of JP '700 shows a locus with frames in order to provide perspective to the driver of the vehicle. App. Br. 36. However, Patent Owner argues that this figure teaches a predicted path that is distorted to match the distorted image that is obtained through the use of a super-wide-angle backup camera and does not indicate a distance. App. Br. 37. Thus, again, Patent Owner contends that JP '700 only teaches a positional relationship that is not the same as reliably indicating what is behind a vehicle. App. Br. 37. The Examiner does not specifically rely on JP '700 to teach the disputed limitation. The Examiner finds that JP '700 teaches displaying the end portion of a vehicle on a backup display and that JP '889 teaches a graphic overlay indicating relative distances. Ans. 4-6. Therefore, the Examiner finds that JP '889 teaches the disputed limitation (Ans. 4-6) and Patent Owner's arguments are not persuasive.

Additionally, Patent Owner argues that JP '889 does not teach the disputed limitation either. App. Br. 38-41; Reply Br. 4-10. The Examiner finds that JP '889 teaches that the horizontal lines of the scale function indicate distances of objects from a vehicle by virtue of being superimposed

at regular, rearward intervals onto an image taken by a rear-facing camera installed on the vehicle. Ans. 4-6; *see also* JP '889, Fig. 2 and accompanying text. We agree with the Examiner that this finding in conjunction with the Examiner's interpretation of the claim, indicated above, is enough to read on the disputed limitation.

Nonetheless, Patent Owner provided expert testimony from Dr. Lynam to attempt to contradict the Examiner's specific finding by presenting a scenario to illustrate the difference between a positional relationship, as found in the references, and an indication of distance. App. Br. 40-41; Reply Br. 5. Specifically, Dr. Lynam contends that when an individual is trying to back up into a parking spot, knowing whether to turn the steering wheel to the right or left (i.e., knowing the position of the vehicle) is a vital piece of information. App. Br. 40-41; *see also* Lynam Decl., ¶ 55. In order to finish parking the vehicle, Dr. Lynam contends, the driver must know the distance between the car and a wall. App. Br. 41; *see also* Lynam Decl. ¶ 55. Thus, Dr. Lynam contends that these are two different types of information. Lynam Decl. ¶ 55. While we have considered the evidence provided by Dr. Lynam, we do not find it to be persuasive. We agree with the Examiner (Ans. 8-9) that the graphic overlay that includes grid lines indicates at least a relative distance behind the vehicle and would indicate to the driver whether there is space (i.e., a particular distance) between the vehicle and an object.

Appellant also argues that the scale of JP '889 does not indicate distances of objects from a vehicle, as is required of the graphic overlay recited by claim, because the numbers that correspond to the horizontal lines of the scale do not indicate distances of objects from a vehicle. App. Br. 38-

39; Reply Br. 8-9. We disagree. As indicated above, the claim does not require that the distances be a numerical number. Even so, the Examiner finds that Figure 2 of JP '889 contains markings that indicate whether an object is closer to the vehicle (50) or farther from the vehicle (200). Ans. 9. The Examiner finds that it is irrelevant the reference does not indicate what type of measurement (i.e., feet/inches) the markings represent as they still represent a distance. Ans. 11-12. Additionally, the Examiner finds that setting the type of measurement would be a design choice. Ans. 11. We agree with the Examiner (Ans. 7-12) that, although not required, JP '889 teaches a particular distance to an object indicated by the horizontal lines marked 50, 100, 150, and 200, in Figure 2. While those numbers do not indicate a particular measurement, we agree with the Examiner that one of ordinary skill in the art could design the system as they saw fit.

Claim 5

Claim 5 recites a "vehicular rearview vision system . . . wherein said graphic overlay comprises at least one horizontal mark superimposed on the displayed image, and wherein said at least one horizontal mark comprises a plurality of short horizontal lines superimposed on the image at regular rearward intervals." Patent Owner argues that neither of the references teaches a plurality of short horizontal lines. App. Br. 42-43. However, the Examiner finds that JP '889 teaches horizontal lines that are spaced at regular intervals that provide the same information as short horizontal lines. Ans. 12. Therefore, the Examiner finds that using short horizontal lines or long horizontal lines is merely a matter of design choice. Ans. 12. We agree with the Examiner as both types provide the same functionality.

Combination of JP '700 with JP '889

Patent Owner also argues that it would not have been obvious to one of ordinary skill in the art at the time of the invention to modify the graphic overlay of JP '700 to incorporate the scale of JP '889 because doing so would result in the scale being distorted in such a way as to render the scale unable to indicate distance. App. Br. 37; *see also* Lynam Decl. ¶ 50. The Examiner finds that JP '700 teaches that the graphic overlay is only distorted when a super-wide camera is used and, even if distorted when combined with JP '889; the combination would provide an indication of distance. Ans. 6; *see also* JP '700, pg. 4. We agree as the combination is nothing more than a combination of familiar elements according to known methods that yields predictable results. *KSR Int'l Co, v. Teleflex, Inc.*, 550 U.S. 398, 416 (2007). Patent Owner has not cited to any evidence to support the assertion that the combination would be "uniquely challenging or difficult for one of ordinary skill in the art." *See Leapfrog Enters., Inc. v. Fisher-Price, Inc.*, 485 F.3d 1157, 1162 (Fed. Cir. 2007) (citing *KSR*, 550 U.S. at 418).

Patent Owner also argues that it would not have been obvious to one of ordinary skill in the art at the time of the invention to modify the graphic overlay of JP '889 to incorporate the scale of JP '889 because the small horizontal marks required by the claims are a nonobvious feature, as evidenced by the commercial success of at least some of the vehicle models that incorporate the horizontal marks. App. Br. 43. We disagree. Although Patent Owner contends that the commercial success of at least some of the vehicle models that incorporate the horizontal marks is due to the horizontal marks rather than some other cause (such as successful marketing), Patent Owner provides no evidence to support Appellant's contention. *See In re*

Huang, 100 F.3d 135, 140 (holding that the inventor's opinion as to the purchaser's reason for buying the product is insufficient to demonstrate a nexus between the sales and the claimed invention).

It follows that Patent Owner has not shown that the Examiner erred in concluding that the combination of JP '700 and JP '889 renders claims 3 and 5 unpatentable. As such, and for all of the reasons stated *supra* we sustain the Examiner's rejection of those claims.

Claims 6-9

The Patent Owner makes the same arguments with respect to claims 6-9 as with claims 3 and 5. App. Br. 44. Therefore, we sustain the Examiner's rejection of these claims for the same reasons discussed *supra*, with respect to claims 3 and 5.

CONCLUSION

The Examiner did not err in finding that the combination of JP '700 and JP '889 teaches or suggests a "vehicular rearview vision system . . . wherein said image enhancement comprises a graphic overlay superimposed on the displayed image indicating distances of objects from the vehicle and wherein said graphic overlay comprises at least one horizontal mark superimposed on the displayed image," as recited in independent claim 3.

The Examiner did not err in finding that the combination of JP '700 and JP '889 teaches or suggests a "vehicular rearview vision system . . . wherein said graphic overlay comprises at least one horizontal mark superimposed on the displayed image, and wherein said at least one

horizontal mark comprises a plurality of short horizontal lines superimposed on the image at regular rearward intervals," as recited in independent claim 5.

The Examiner did not err in combining JP '700 and JP '889.

SUMMARY

We affirm the Examiner's decision to adopt the rejection of claims 3 and 5-9 as obvious over the combination of JP '700 and JP '889.

AFFIRMED

Appeal 2013-006429
Reexamination Control No. 90/011,477
Patent 5,949,331

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Exhibit A

US005949331A

United States Patent [19]

Schofield et al.

[11] Patent Number: 5,949,331

[45] Date of Patent: *Sep. 7, 1999

[54] **DISPLAY ENHANCEMENTS FOR VEHICLE VISION SYSTEM**

[75] Inventors: **Kenneth Schofield**, Holland; **Mark L. Larson**, Grand Haven; **Keith J. Vadas**, Coopersville, all of Mich.

[73] Assignee: **Donnelly Corporation**, Holland, Mich.

[*] Notice: This patent is subject to a terminal disclaimer.

[21] Appl. No.: **08/935,336**

[22] Filed: **Sep. 22, 1997**

Related U.S. Application Data

[63] Continuation of application No. 08/445,527, May 22, 1995, Pat. No. 5,670,935, which is a continuation-in-part of application No. 08/023,918, Feb. 26, 1993, Pat. No. 5,550,677.

[51] **Int. Cl.**[6] **B60Q 1/00**

[52] **U.S. Cl.** **340/461**; 340/435; 340/436; 340/438; 340/439; 340/903; 701/301

[58] **Field of Search** 340/435, 436, 340/901, 903, 461, 438, 439, 462; 348/118, 148; 701/116, 117, 301

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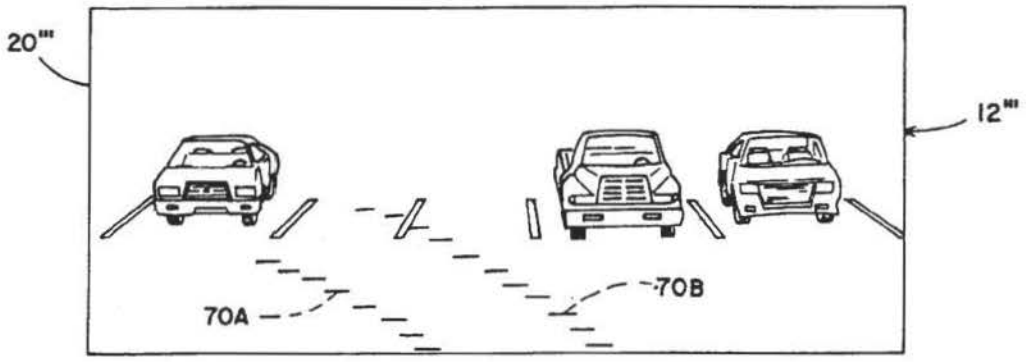
Primary Examiner—Jeffery A. Hofsass
Assistant Examiner—Ashok Mannava
Attorney, Agent, or Firm—Van Dyke, Gardner, Linn & Burkhart, LLP

[57] **ABSTRACT**

A vision system for a vehicle includes at least one image capture device which may be directed rearwardly with respect to the direction of travel of the vehicle. A display system displays an image synthesized from an output of the image capture device. The display system enhances the displayed image by visually informing the driver of what is occurring in the area surrounding the vehicle. For example, hazards, such as objects too close to the vehicle for safe lane-change maneuver, can be highlighted such as by flashing the image of the hazard or displaying the hazard in a particular color.

64 Claims, 7 Drawing Sheets



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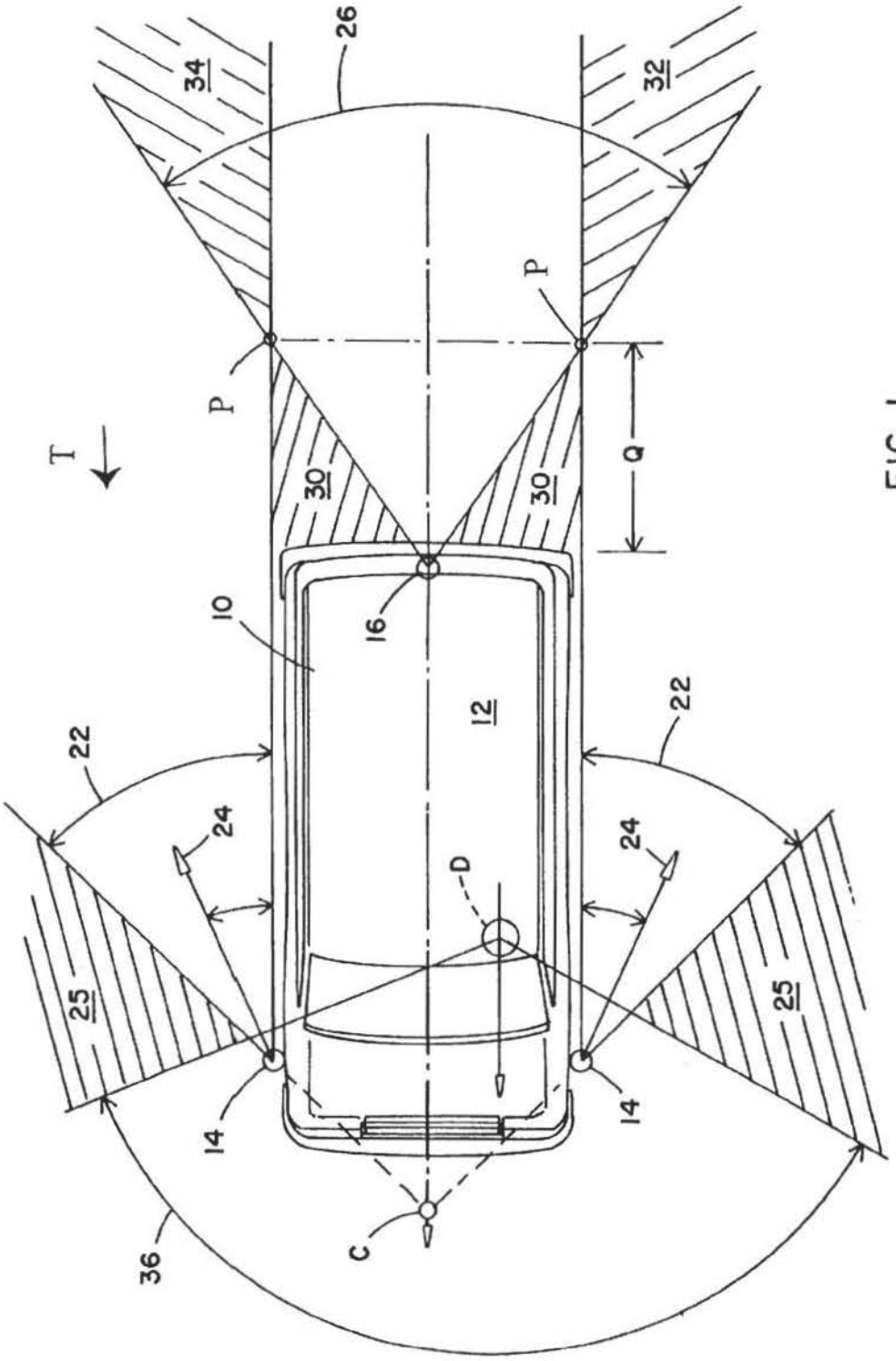


FIG. 1

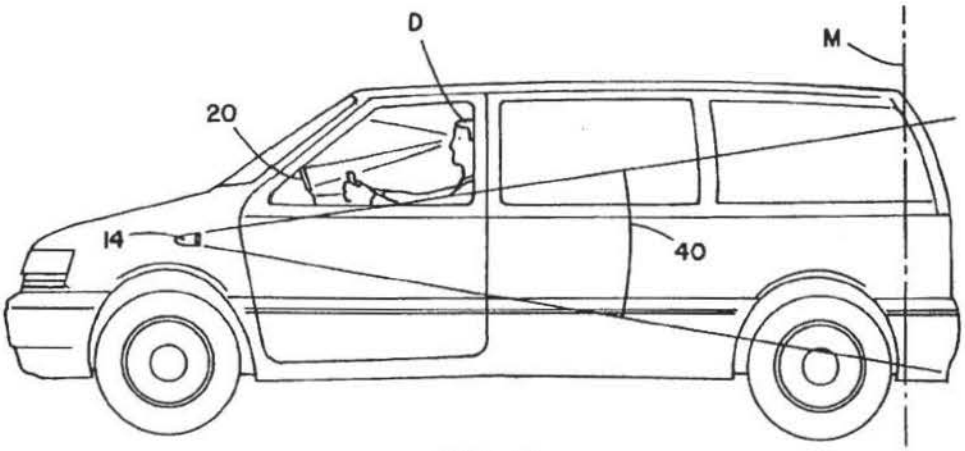


FIG. 2

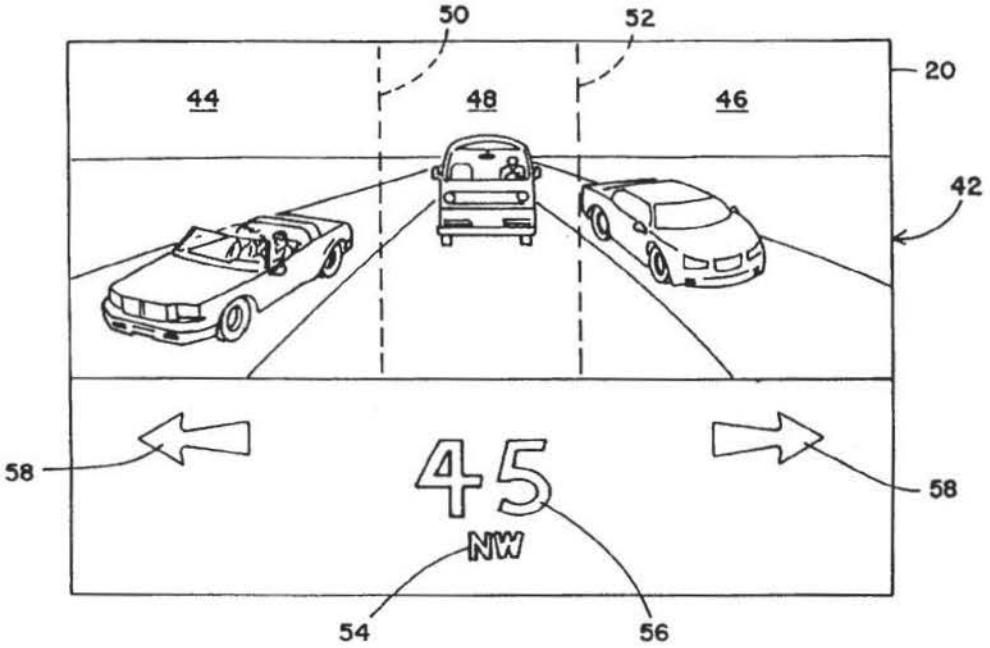


FIG. 3

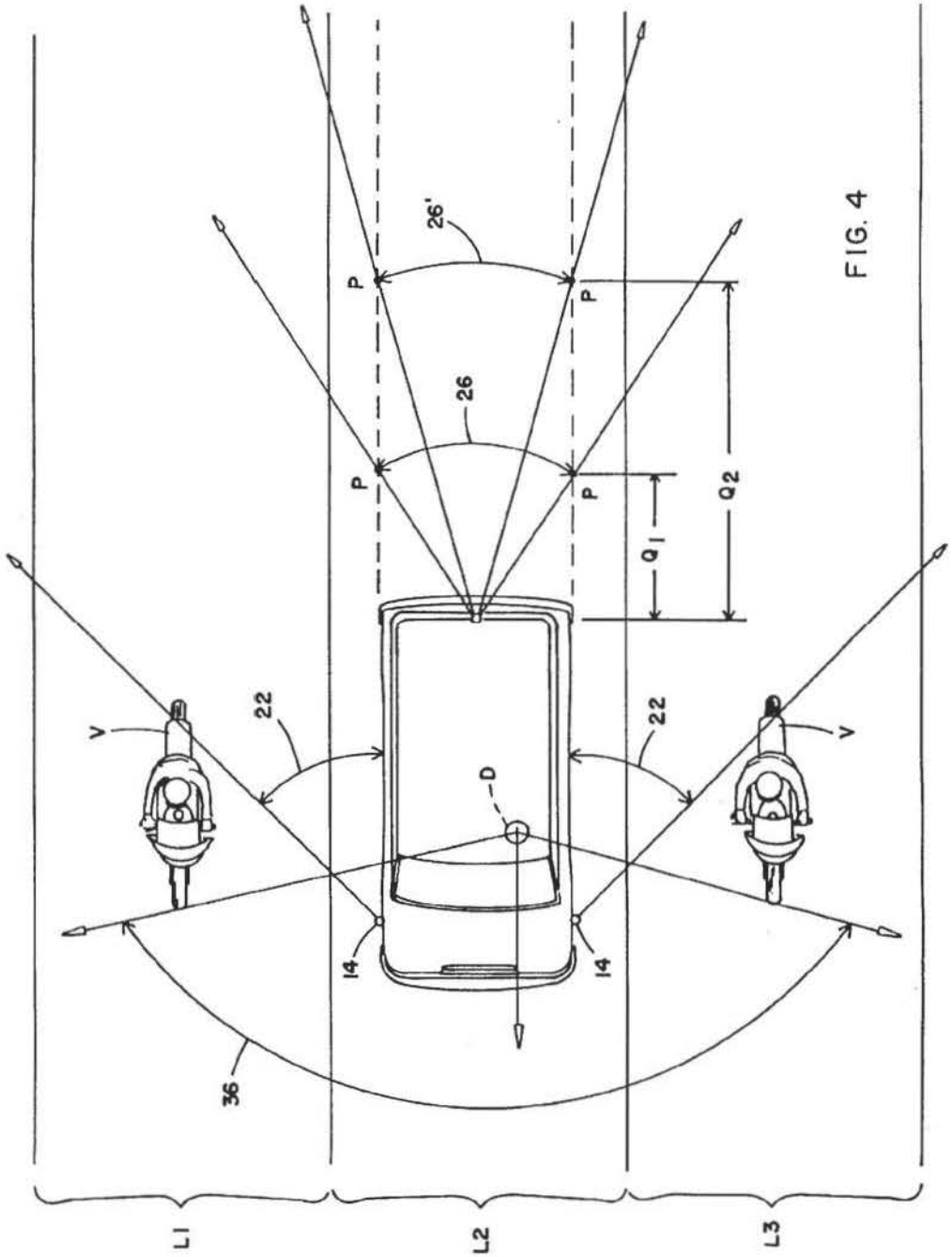


FIG. 4

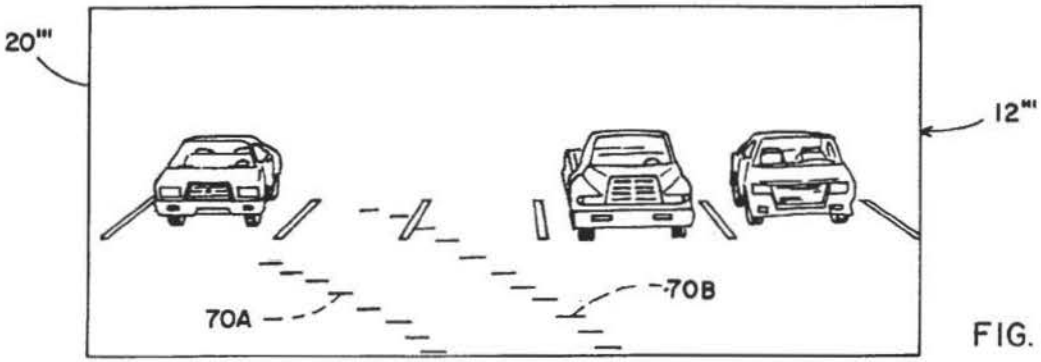


FIG. 6

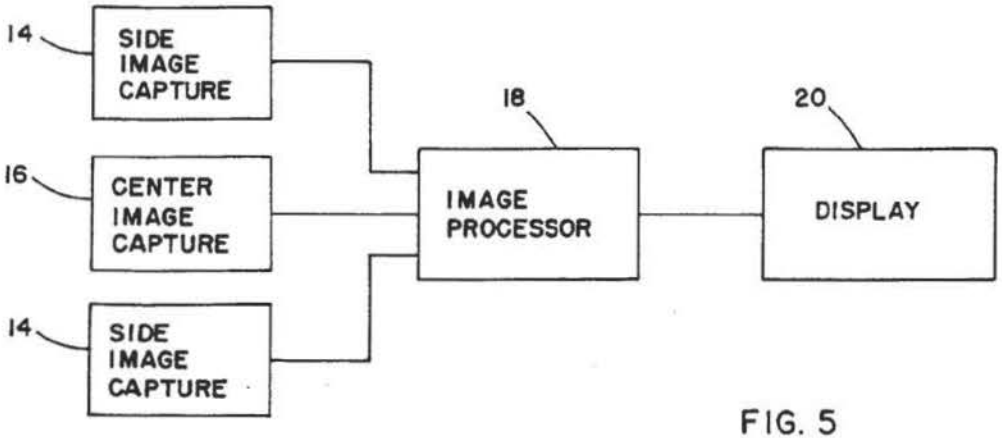


FIG. 5

A24

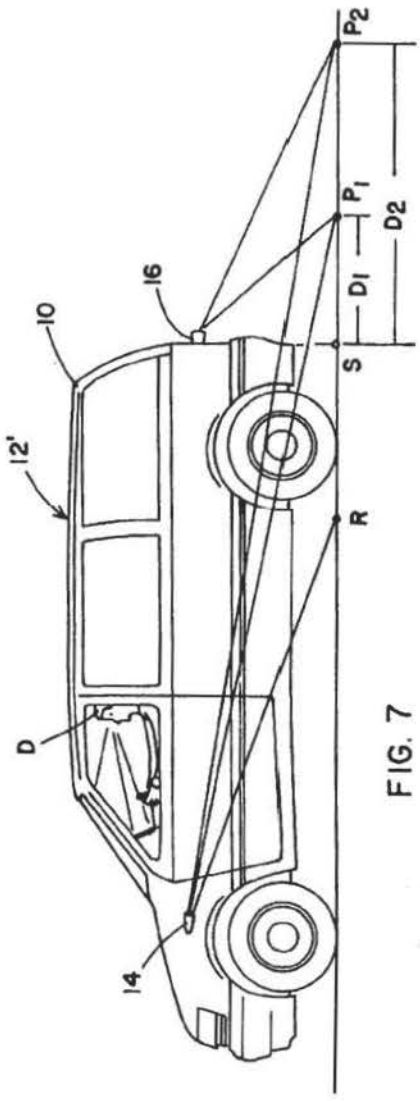


FIG. 7

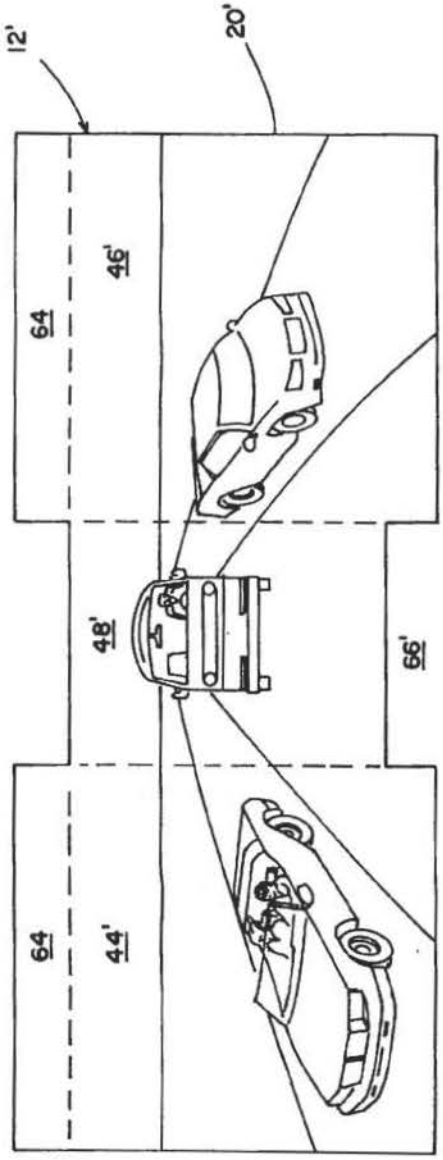
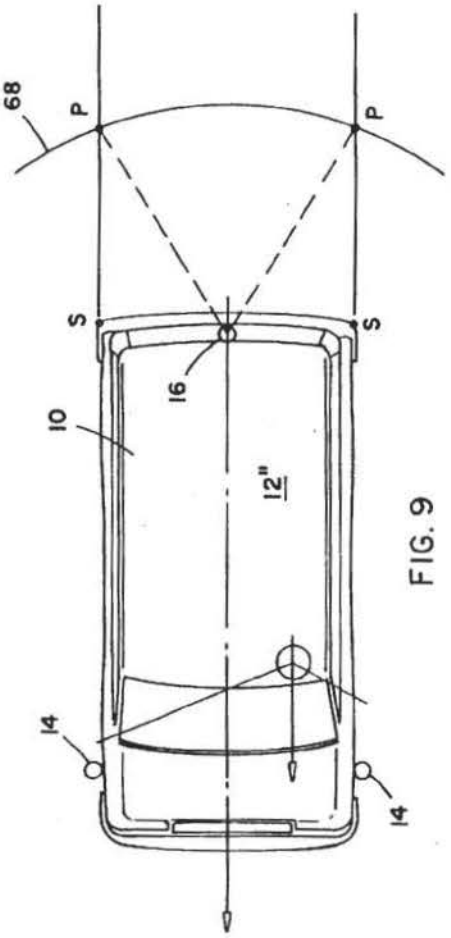


FIG. 8


68
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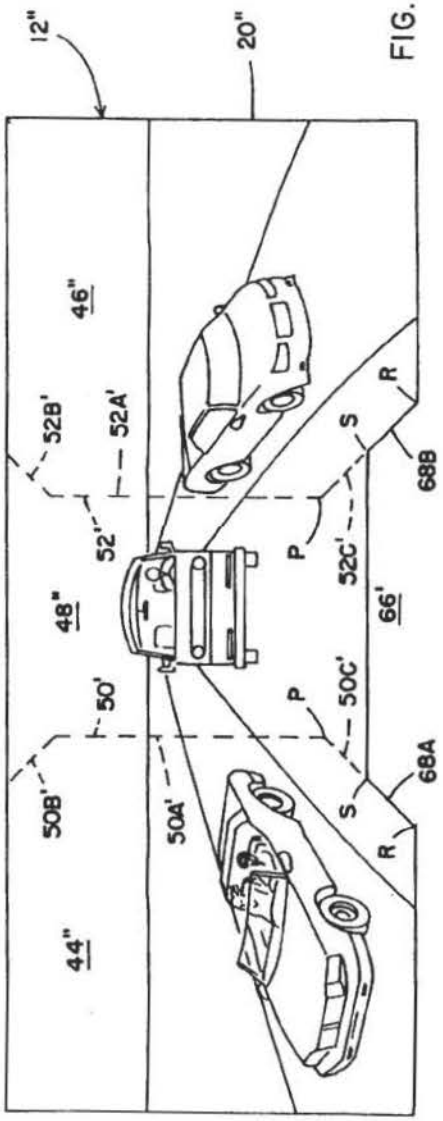
14

FIG. 9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48"
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50B'
50A'
S
68A
R
44"

FIG. 10

92 N1	94 N2
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92 N1	94 N2
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FIG. 11

DISPLAY ENHANCEMENTS FOR VEHICLE VISION SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation of application Ser. No. 08/445,527, filed on May 22, 1995, now U.S. Pat. No. 5,670,935, which is a continuation-in-part of patent application Ser. No. 08/023,918 filed Feb. 26, 1993, by Kenneth Schofield and Mark Larson, now U.S. Pat. No. 5,550,677.

BACKGROUND OF THE INVENTION

This invention relates generally to vision systems for vehicles and, more particularly, to rearview vision systems which provide the vehicle operator with scenic information in the direction rearward of the vehicle. More particularly, the invention relates to a rearview vision system utilizing image capture devices, such as CMOS imaging arrays and the like.

A long-felt need in the art of vehicle rearview vision systems has been to eliminate exterior rearview mirrors by utilizing image capture devices, such as cameras, in combination with dashboard displays. This would be beneficial because it would reduce wind drag on the vehicle, wind noise and vehicle weight. Furthermore, rearview mirrors protrude a substantial distance from the side of the vehicle, which makes maneuvering in tight spaces more difficult. Image capture devices are capable of positioning in a greater variety of locations on the vehicle, providing more flexibility of vehicle styling. It is further expected that camera systems would greatly reduce the blind spots to the sides and rear of the vehicle common with vehicles equipped with conventional rearview mirror systems. The driver cannot perceive vehicles, objects, or other road users in such blind spots without turning his or her body, which interferes with forward-looking visual activities.

Camera-based rearview vision systems for vehicles have not obtained commercial acceptance. One difficulty with proposed systems has been that they present a large amount of visual information in a manner which is difficult to comprehend. This difficulty arises from many factors. In order to significantly reduce blind spots, multiple image capture devices are typically positioned at various locations on the vehicle. The image of an object behind the equipped vehicle is usually captured by more than one image capture device at a time and displayed in multiple images. This may confuse the driver as to whether more than one object is present. When multiple image capture devices are positioned at different longitudinal locations on the vehicle, objects behind the vehicle are at different distances from the image capture devices. This results in different image sizes for the same object. This effect is especially noticeable for laterally extending images, such as a bridge, highway crosswalk markings, the earth's horizon, and the like. Such images are at different vertical angles with respect to the image capture devices. This results in different vertical positions on the display causing the elongated image to appear disjointed.

A camera system provides a monocular view of the scene, compared to the binocular, or stereoscopic, view obtained when the scene is viewed through a rearview mirror. This makes the ability to judge distances in a camera system a problem. This effect is most noticeable at distances close to the vehicle where stereoscopic imaging is relied upon extensively by the driver in judging relative locations of objects. Therefore, known camera systems fail to provide to the driver important information where that information is most needed—at small separation distances from surrounding objects.

Another difficulty with camera systems is that, in order to provide a sufficient amount of information, the camera system typically presents the driver with a greatly increased field of view. This improves performance by further reducing blind spots at the side and rear of the vehicle. However, an increased field of view is often obtained by utilizing a wide-angle lens which introduces distortion of the scene and further impairs the ability of the driver to judge distances of objects displayed. The problem with such distortion of the scene is that the driver must concentrate more on the display and take a longer time to interpret and extract the necessary information. This further distracts the driver from the primary visual task of maintaining awareness of vehicles and other objects in the vicinity of the driven vehicle.

SUMMARY OF THE INVENTION

The present invention is directed towards enhancing the interpretation of visual information in a rearview vision system by presenting information in a manner which does not require significant concentration of the driver or present distractions to the driver. This is accomplished according to the invention in a rearview vision system having at least two image capture devices positioned on the vehicle and directed rearwardly with respect to the direction of travel of the vehicle. A display is provided for images captured by the image capture devices. The display combines the captured images into an image that would be achieved by a single rearward-looking camera having a view unobstructed by the vehicle. In order to obtain all of the necessary information of activity, not only behind but also along side of the vehicle, the virtual camera should be positioned forward of the driver. The image synthesized from the multiple image capture devices may have a dead space which corresponds with the area occupied by the vehicle. This dead space is useable by the driver's sense of perspective in judging the location of vehicles behind and along side of the equipped vehicle.

The present invention provides techniques for synthesizing images captured by individual, spatially separated, image capture devices into such ideal image, displayed on the display device. This may be accomplished according to an aspect of the invention by providing at least three image capture devices. At least two of the image capture devices are side image capture devices mounted on opposite sides of the vehicle. At least one of the image capture devices is a center image capture device mounted laterally between the side image capture devices. A display system displays an image synthesized from outputs of the image capture devices. The displayed image includes an image portion from each of the image capture devices. The image portion from the center image capture device is vertically compressed.

It has been discovered that such vertical compression substantially eliminates distortion resulting from the spatial separation between the cameras and can be readily accomplished. In an illustrated embodiment, the image compression is carried out by removing selective ones of the scan lines making up the image portion. A greater number of lines are removed further away from the vertical center of the image.

The compression of the central image portion produces a dead space in the displayed image which may be made to correspond with the area that would be occupied by the

vehicle in the view from the single virtual camera. Preferably, perspective lines are included at lateral edges of the dead space which are aligned with the direction of travel of the vehicle and, therefore, appear in parallel with lane markings. This provides visual clues to the driver's sense of perspective in order to assist in judging distances of objects around the vehicle.

According to another aspect of the invention, image enhancement means are provided for enhancing the displayed image. Such means may be in the form of graphic overlays superimposed on the displayed image. Such graphic overlap may include indicia of the anticipated path of travel of the vehicle which is useful in assisting the driver in guiding the vehicle in reverse directions. Such graphic overlay may include a distance grid indicating distances behind the vehicle of objects juxtaposed with the grid.

These and other objects, advantages, and features of this invention will become apparent by review of the following specification in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top plan view of a vehicle having a rearview vision system according to the invention;

FIG. **2** is a side elevation of the vehicle in FIG. **1**;

FIG. **3** is a front elevation of a display according to the invention;

FIG. **4** is the same view as FIG. **1** illustrating an alternative embodiment of the invention;

FIG. **5** is a block diagram of an electronic system according to the invention;

FIG. **6** is the same view as FIG. **3** illustrating an alternate mode of operation of the system;

FIG. **7** is the same view as FIG. **2** illustrating an alternative embodiment of the invention;

FIG. **8** is the same view as FIG. **3** illustrating an alternative embodiment of the invention;

FIG. **9** is the same view as FIGS. **1** and **4** illustrating an alternative embodiment of the invention;

FIG. **10** is the same view as FIGS. **3** and **8** illustrating an alternative embodiment of the invention; and

FIG. **11** is a chart illustrating the horizontal row of pixels (n1, n2) on which an object will be imaged from two longitudinally separated image capture devices as that object is spaced at different longitudinal distances from the image capture devices.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now specifically to the drawings, and the illustrative embodiments depicted therein, a vehicle **10**, which may be an automobile, a light truck, a sport utility vehicle, a van, a bus, a large truck, or the like includes a rearview vision system, generally illustrated at **12**, for providing a driver of the vehicle with a view rearwardly of the vehicle with respect to the direction of travel D of the vehicle (FIG. **1**). Vision system **12** includes at least two side image capture devices **14** positioned, respectively, on opposite sides of vehicle **10** and a center image capture device **16** positioned on the lateral centerline of the vehicle. All of the image capture devices are directed generally rearwardly of the vehicle. Rearview vision system **12** additionally includes an image processor **18** for receiving data signals from image capture devices **14**, **16** and synthesizing, from the data signals, a composite image **42** which is displayed on a display **20**.

As will be set forth in more detail below, the images captured by image capture devices **14**, **16** are juxtaposed on display **20** by image processor **18** in a manner which approximates the view from a single virtual image capture device positioned forwardly of the vehicle at a location C and facing rearwardly of the vehicle, with the vehicle being transparent to the view of the virtual image capture device. Vision system **12** provides a substantially seamless panoramic view rearwardly of the vehicle without duplicate or redundant images of objects. Furthermore, elongated, laterally-extending, objects, such as the earth's horizon, appear uniform and straight across the entire displayed image. The displayed image provides a sense of perspective, which enhances the ability of the driver to judge location and speed of adjacent trailing vehicles.

Each of side image capture devices **14** has a field of view **22** and is aimed rearwardly with respect to the vehicle about an axis **24** which is at an angle, with respect to the vehicle, that is half of the horizontal field of view of the image capture device. In this manner, each of the image capture devices **14** covers an area bounded by the side of the vehicle and extending outwardly at an angle defined by the horizontal field of view of the respective side image capture device. Center image capture device **16** has a horizontal field of view **26**, which is symmetrical about the longitudinal axis of the vehicle. The field of view of each side image capture device **14** intersect the field of view of center image capture device **16** at a point P which is located a distance Q behind vehicle **10**.

Rear blind zones **30** are located symmetrically behind vehicle **10** extending from the rear of the vehicle to point P. Side blind zones **25** located laterally on respective sides of the vehicle extend rearwardly of the forward field of view **36** of the driver to the field of view **22** of the respective side image capture device **14**. An object will not be captured by side image capture devices **14** or center image capture devices **16** if the object is entirely within one of the blind zones **25**, **30**. In order for an object, such as another vehicle V or other road user travelling to the side of vehicle **10**, to be observed by an operator of vehicle **10**, the object must be either at least partially within the forward field of view **36** of the driver or be captured by image capture devices **14**, **16** and displayed on display **20**. FIG. **4** illustrates vehicle **10** travelling on a three-lane highway having lanes L1, L2, and L3 with the vehicle in lane L2. Another vehicle V is shown positioned mostly within one of the blind zones **25**, but with the rearmost portion of the vehicle V extending into field of view **22** where the vehicle image will be captured by one of side image capture devices **14**. In the illustrated embodiment, vehicle V is a motorcycle travelling in the center of lanes L1 or L3 and represents a worst case for observing a vehicle travelling at least partially within one of the blind zones **25**. In order for a portion of vehicle V to be extending either forwardly or rearwardly of the respective blind zone **25**, where the vehicle V may be observed by either the forward field of view **36** of the driver or by the rearview vision system **12**, the field of view **22** of side image capture devices **14** must be sufficiently wide to capture a portion of vehicle V as illustrated in FIG. **4**. Preferably, the horizontal field of view **22** of side image capture devices **14** is no greater than that required to provide sufficient coverage which would be in the range of between approximately 55 degrees and approximately 70 degrees. In the illustrated embodiment, the horizontal field of view **22** is 61 degrees. In order for a portion of vehicle V to be within a vertical field of view **40** of one of side image capture devices **14**, the field of view should extend to the pavement at a plane M which

intersects vehicle V (FIG. 2). Preferably, vertical field of view **40** is between approximately 60 degrees and approximately 75 degrees. In the illustrated embodiment, vertical field of view **40** is 66 degrees.

A left overlap zone **32** and a right overlap zone **34** extend rearward from respective points P where the horizontal fields of view of the side image capture devices intersect the field of view of center image capture device **16**. Overlap zones **32, 34** define areas within which an object will be captured both by center image capture device **16** and one of the side image capture devices **14**. An object in an overlap zone **32, 34** will appear on display **20** in multiple image portions in a redundant or duplicative fashion. In order to avoid the presentation of redundant information to the driver, and thereby avoid confusion and simplify the task of extracting information from the multiple images or combined images on display **20**, the object should avoid overlapping zones **32, 34**. In practice, this may be accomplished to a satisfactory extent by moving points P away from the vehicle and thereby increasing distance Q. It is desirable to increase distance Q to a length that will exclude vehicles travelling at a typical separation distance behind vehicle **10** from overlapping zones **32, 34**. This separation distance is usually a function of the speed at which the vehicles on the highway are travelling. The faster the vehicles are travelling, the further Q should be moved behind vehicle **10** to keep overlap zones **32** and **34** outside of the recommended vehicle spacing. If, however, the vehicles are travelling at a slower speed, then the generally accepted recommendation for vehicle spacing decreases and it is more likely that a vehicle will be within overlap zone **32, 34**. Therefore, the distance Q may be selected to accommodate expected vehicle spacing for an average driving speed of vehicle **10**.

Distance Q is a function of the effective horizontal field of view **26** of center image capture device **16**. As field of view **26** decreases, points P move further rearward of the vehicle from a distance Q_1, to a distance Q_2, as best illustrated in FIG. **4**. In order to increase distance Q to eliminate redundant and duplicative information displayed on display **20** for most driving conditions of vehicle **10**, field of view **26** is preferably less than 12 degrees. In the illustrated embodiment, field of view **26** is between 6 and 8 degrees. Alternatively, distance Q may be dynamically adjusted according to some parameter, such as the speed of vehicle **10**. This would allow Q to be greater when the vehicle is travelling at a faster speed, where vehicle separation tends to be larger, and vice versa. Field of view **26** may be adjusted by utilizing a selective presentation of pixels of the captured image in the displayed image.

Referring to FIG. **3**, image display device **20** displays a composite image **42** made up of a left image portion **44**, a right image portion **46**, and a center image portion **48**. Each image portion **44–48** is reversed from the image as captured by the respective image capture device **14, 16** utilizing conventional techniques. These techniques include reading the image in reverse with the image capture device, writing the image in reverse to display device **20**, or reversing the image in image processor **18**. Left image portion **44** is joined with central image portion **48** at a boundary **50**. Central image portion **48** is joined with right image portion **46** at a boundary **52**. As may best be seen in FIG. **3**, the image portions at boundaries **50** and **52** are continuous whereby composite image **42** is a seamless panoramic view rearwardly of the vehicle. As also is apparent from FIG. **3**, central image portion **48** is narrower than either left image portion **44** or right image portion **46**. This is a result of reducing the horizontal field of view **26** of center image capture device **16** sufficiently to move points P, and thus overlap zones **32** and **34**, a sufficient distance behind vehicle **10** to reduce redundant and duplicative images between image portions **44–48**. Composite image **42** provides a clear image, which avoids confusion and simplifies the task of extracting information from the multiple image portions **44–48**. As also may be seen by reference to FIG. **3**, display **20** may additionally include indicia such as the readout of a compass **54**, vehicle speed **56**, turn signals **58**, and the like as well as other graphical or video displays, such as a navigation display, a map display, and a forward-facing vision system. In this manner, rearview vision system **12** may be a compass vision system or an information vision system.

In the embodiment of rearview vision system **12** having a dynamically adjusted value of distance Q, the spacing between boundaries **50** and **52** will dynamically adjust in sequence with the adjustment of distance Q. Thus, as overlap zones **32, 34** move further away from the vehicle; for example, in response to an increase in speed of the vehicle, boundary lines **50** and **52** will move closer together and vice versa. In this manner, composite image **42** is dynamic, having image portions of dynamically adaptive sizes.

Display **20** is of a size to be as natural as possible to the driver. This is a function of the size of the display and the distance between the display and the driver. Preferably, the displayed image simulates an image reflected by a rearview mirror. As such, the size of display **20** is approximately the combined areas of the three rearview mirrors (one interior mirror and two exterior mirrors) conventionally used with vehicles. As best seen by reference to FIG. **2**, display **20** is preferably positioned within the driver's physiological field of view without obstructing the view through the windshield. It is known that the driver's field of view, with the head and eyes fixed forward, extends further in a downward direction than in an upward direction. Display **20** could be located above the vertical view through the windshield wherein the display may be observed at the upward portion of the driver's field of view. However, the position for the display illustrated in FIG. **2** is preferred wherein the display is within the lower portion of the driver's field of view.

Display **20**, in the illustrated embodiment, is a flat panel display, such as a back-lit liquid crystal display, a plasma display, a field emission display, or a cathode ray tube. However, the synthesized image could be displayed using other display techniques such as to provide a projected or virtual image. One such virtual display is a heads-up display. The display may be mounted/attached to the dashboard, facia or header, or to the windshield at a position conventionally occupied by an interior rearview mirror.

Although various camera devices may be utilized for image capture devices **14, 16**, an electro-optic, pixelated imaging array, located in the focal plane of an optical system, is preferred. Such imaging array allows the number of pixels to be selected to meet the requirements of rearview vision system **12**. The pixel requirements are related to the imaging aspect ratio of the respective image capture devices, which, in turn, are a function of the ratio of the vertical-to-horizontal field of view of the devices, as is well known in the art. In the illustrated embodiment, the imaging aspect ratio of side image capture devices **14** is 2:1 and the image aspect ratio of central image capture device **16** is variable down to 0.1:1. Such aspect ratio will produce images which will not typically match that of commercially available displays. A commercially available display may be used, however, by leaving a horizontal band of the display for displaying alpha-numeric data, such as portions of an instrument cluster, compass display, or the like, as illustrated in FIG. **3**.

In the illustrated embodiment, image capture devices **14**, **16** are CMOS imaging arrays of the type manufactured by VLSI Vision Ltd. of Edinburgh, Scotland, which are described in more detail in U.S. Pat. No. 5,550,677 issued to Kenneth Schofield and Mark Larson for an AUTOMATIC REARVIEW MIRROR SYSTEM USING A PHOTOSENSOR ARRAY, the disclosure of which is hereby incorporated herein by reference. However, other pixelated focal plane image-array devices, which are sensitive to visible or invisible electromagnetic radiation, could be used. The devices could be sensitive to either color or monochromatic visible radiation or near or far infrared radiation of the type used in night-vision systems. Each image capture device could be a combination of different types of devices, such as one sensitive to visible radiation combined with one sensitive to infrared radiation. Examples of other devices known in the art include charge couple devices and the like.

Preferably, image capture devices **14** and **16** are all mounted at the same vertical height on vehicle **10**, although compromise may be required in order to accommodate styling features of the vehicle. The horizontal aim of image capture devices **14** and **16** is preferably horizontal. However, the portion of the image displayed is preferably biased toward the downward portion of the captured image because significantly less useful information is obtained above the horizontal position of the image capture devices.

Each image-capturing device **14**, **16** is controlled by appropriate supporting electronics (not shown) located in the vicinity of the imaging array such that, when operating power is supplied, either an analog or a digital data stream is generated on an output signal line supplied to image processor **18**. The support electronics may be provided partially on the image chip and partially on associated electronic devices. For each exposure period, a value indicative of the quantity of light incident on each pixel of the imaging array during the exposure period is sequentially outputted in a predetermined sequence, typically row-by-row. The sequence may conform to video signal standards which support a direct view such that, when a scene is viewed by an image-capturing device, the image presented on a display represents directly the scene viewed by the image-capturing devices. However, when looking forward and observing a displayed image of a rearward scene, the driver will interpret the image as if it were a reflection of the scene as viewed through a mirror. Objects to the left and rearward of the vehicle, as viewed by the rearward-looking camera, are presented on the left-hand side of the display and vice versa. If this reversal is effected in image processor **18**, it may be by the use of a data storage device, or buffer, capable of storing all of the pixel values from one exposure period. The data is read out of the data storage device in a reversed row sequence. Alternatively, the imaging array electronics could be constructed to provide the above-described reversal at the image-capturing device or at the display.

Data transmission between image capture devices **14**, **16** and image processor **18** and/or between image processor **18** and display **20** may be by electrically conductive leads or fiber-optic cable. It is possible, for particular applications, to eliminate image processor **18** and direct drive display **20** from image capture devices **14**, **16** at the pixel level.

The data streams from image-capturing devices **14**, **16** are combined in image processor **18** and directly mapped to the pixel array of display **20**. This process is repeated preferably at a rate of at least 30 times per second in order to present an essentially real time video image. The image captured by side image capture device **14** on the right side of the vehicle is presented in right image portion **46** and the image from side image capture device **14** on the left side of the vehicle is displayed on left image portion **44**. The image from center image capture device **16** is displayed on central image portion **48**. The three image portions **44**–**48** are presented in horizontal alignment and adjacent to each other. However, the composite image may be positioned at any desired vertical position in the display **20**. It is also possible to display image portions **44**–**48** on separate image devices which are adjacent each other.

In vision system **12**, side image capture devices **14** are positioned preferably at a forward longitudinal position on vehicle **10** and center image capture device **16** is positioned at a rearward longitudinal position on the vehicle. As best seen by reference to FIG. **7**, this positioning creates a difference in the vertical angle between each side image capture device **14** and center image capture device **16** with respect to a fixed location P_1 that is a distance D_1 behind the vehicle. This difference in sensing angle will cause each side image capture device **14** to image an object located at P_1 on a horizontal row of pixels that is different from the horizontal row of pixels that center image capture device **16** will image the same object. If the image is below the horizontal centerline of the image capture device, it will be imaged on a lower row of pixels by center image capture device **16** than the row of pixels it will be imaged by the side image capture devices **14**, as illustrated in FIG. **7**. This mismatch between horizontal pixel rows of the captured image is furthermore a function of the distance of the captured image from the rear of the vehicle. This can be understood by reference to FIG. **11** which presents a chart **90** having a first column **92** of pixel lines n1, measured from the array centerline, at which an object will be imaged by side image capture device **14** and a second column **94** of pixel lines n2, measured from the array vertical centerline, at which the same object will be imaged by center image capture device **16**. The result is that an object, which is captured by both side and center image capture devices **14**, **16**, will be vertically disjointed at the boundary of the displayed image, if the object is captured by more than one image capture device. The amount of disjointment will be greater closer to the vehicle and less at further distances. If the object is elongated in the horizontal direction, such as earth's horizon, bridges, or cross-markings on highways, then the object will appear to be either broken or crooked.

In order to provide uniform display of laterally elongated images, a rearview vision system **12'** is provided having a central image portion **48'** which is processed differently from the image display portions **44'** and **46'** produced by the side image capture devices (FIG. **8**). Central image portion **48'** is reduced vertically, or compressed, by removing specified scan lines, or pixel rows, from the image captured by center image capture device **16** in a graduated fashion. The difference in the pixel line at which an object will be imaged by each of the side and center image capture devices is a function of the distance D of the object from the rear of the vehicle, with a greater variation occurring at shorter distances and the variation reducing to zero for infinite distances. Therefore, the compression of central image portion **48'** is non-linear, with substantially no compression at the vertical center of the image and greater compression at greater distances above and below the vertical center point of the image. This is accomplished by removing specific lines from the center display in a graduated fashion with a greater number of lines removed further from the vertical center of the image. The removed lines may be merely discarded in order to vertically reduce the image.

Alternatively, the data contained in the removed lines may be utilized to modify the value of adjacent pixels above and below the removed line in order to enhance the quality of the compressed image. Averaging, median filtering, or other such known techniques may also be used.

Each of right image portion **46'** and left image portion **44'** includes an upper portion **64** which extends above the compressed upper portion of the central image portion **48'**. In the illustrated embodiment, upper portions **64** are deleted in order to present a uniform upper horizontal boundary for display **20'**. In the illustrated embodiment, the mismatch between the lower horizontal boundary of central image portion **48'** and each of the left and right image portions provides a dead space **66** which provides a visual prompt to the user of the approximate location of the rearward corners S of vehicle **10**. This dead space **66** in the image displayed on display **20'** approximates the footprint occupied by vehicle **10** when viewed from point C. This is particularly useful because it provides a visual indication to the driver that a vehicle passing vehicle **10**, as viewed in either left image portion **44'** or right image portion **46'**, is at least partially adjacent vehicle **10** if the image of the approaching vehicle is partially adjacent to dead space **66**.

In an alternative embodiment, the vertical compression technique may be applied to only a lower vertical portion of central image portion **48'**. In most driving situations, objects imaged by rearward-facing image capture devices above the horizon are at a long distance from the vehicle while those below the horizon get progressively closer to the vehicle in relation to the distance below the horizon in the displayed image. Therefore, compression of the upper vertical portion of the central image portion may be eliminated without significant reduction in performance.

Compression of the central image portion may also advantageously be provided horizontally, as well as vertically. Spatial separation of center image capture device **16** from side image capture devices **14** causes similar distortion, as that described above, in the horizontal direction. This effect is spherical in nature and would require a more complex corrective action, such as compressing the image based upon the removal of pixels from an approximation to concentric circles centered on the center of the imaging array, or other techniques which would be apparent to those skilled in the art.

A rearview vision system **12"** includes an image display **20"** having a compressed central image portion **48"** and left and right image portions **44"** and **46"**, respectively (FIG. **10**). A border **50'** between left side image **44"** and central image **48"** includes a vertical central border portion **50***a*', an upper border portion **50***b*', and a lower border portion **50***c*'. Upper border portion **50***b*' and lower border portion **50***c*' diverge laterally outwardly, vertically away from central portion **50***a*'. A border **52'** between central Iimage portion **48"** and right image portion **46"** includes a central boundary portion **52***a*', an upper boundary portion **52***b*', and a lower boundary portion **52***c*'. Upper boundary portion **52***b*' and lower boundary portion **52***c*' diverge laterally outwardly vertically away from central portion **52***a*'. This creates an upper portion of central image portion **48"** and a lower portion of central image portion **48"** which extend beyond the center portion thereof. This configuration is based upon the realization that the surface of the road immediately behind the vehicle is captured by central image capture device **16**. Likewise, the horizontal plane above the vehicle, which is symmetrical with the road surface, is captured by the center image capture device. This may be seen by referring to point P in FIG. **10**, which illustrate the points where the effective radius **68** of the virtual image capture device intersects dead zones **30** and by referring to point S in FIG. **10** which illustrates the corners or the rear of the vehicle (S).

The image displayed on display **20"** includes a dead space **66'** having diverging lateral sides **68***a*, **68***b*. Diverging sides **68***a* and **68***b* are configured in order to extend in the direction of travel of vehicle **10** which is parallel to lane markings of a highway on which vehicle **10** is travelling. This further enhances the visual perception of the driver by providing a visual clue of the location of images appearing on display **20"** with respect to the vehicle **10**. Side portions **68***a*, **68***b*, in the illustrated embodiment, are natural extensions of lower boundary portions **50***c*' and **52***c*' and extend from point S on each respective side of the vehicle to point R, which represents the intersection of the lower extent of the vertical field of view **40** of each side image capture device **14** with the pavement (FIG. 7).

Rearview vision systems **12'** and **12"** utilize a displayed synthesized image which takes into account the use of perspective in enhancing the driver's understanding of what is occurring in the area surrounding the vehicle. The images produced on displays **20'** and **20"** effectively remove the vehicle bodywork and replace the bodywork with a vehicle footprint as would be viewed by virtual camera C. The image displayed on display **20"** further includes perspective lines which further enhance the roll of perspective in the driver's understanding of what is occurring.

In order to further enhance the driver's understanding of what is occurring in the area surrounding the vehicle, a rearview vision system **12'"** includes a display **20'"** having image enhancements (FIG. **6**). In the illustrative embodiment, such image enhancements include graphic overlays **70***a*, **70***b* which are hash marks intended to illustrate to the driver the anticipated path of movement of vehicle **10**. In the illustrated embodiment, the anticipated vehicle motion is a function of the vehicle direction of travel as well as the rate of turn of the vehicle. The forward or rearward direction of vehicle travel is determined in response to the operator placing the gear selection device (not shown) in the reverse gear position. The degree of turn of the vehicle may be determined by monitoring the movement of the vehicle steering system, monitoring the output of an electronic compass, or monitoring the vehicle differential drive system. In the embodiment illustrated in FIG. **6**, the configuration of graphic overlays **70***a*, **70***b* indicates that the vehicle is in reverse gear and that the wheels are turned in a manner that will cause the vehicle to travel toward the driver's side of the vehicle. If the wheels were turned in the opposite direction, graphic overlays **70***a*, **70***b* would curve clockwise toward the right as viewed in FIG. **6**. If the vehicle's wheels were straight, graphic overlays **70***a*, **70***b* would be substantially straight converging lines. If the vehicle is not in reverse gear position, graphic overlays **70***a*, **70***b* are not presented. Other types of graphic overlays of the displayed image are comprehended by the invention.

Horizontal grid markings on the display may be provided to indicate distances behind the vehicle at particular markings. Such grid would allow the driver to judge the relative position of vehicles behind the equipped vehicle. In one embodiment, short horizontal lines are superimposed on the displayed image at regular rearward intervals in horizontal positions which correspond to the boundaries of the lane in which the vehicle is travelling. In order to avoid confusion when the vehicle is travelling in a curved path, from a lack of correspondence between the graphic overlay and the road, a signal indicative of the vehicle's rate of turn may be taken into account when generating the graphic overlay. In this

manner, the distance indications may be moved laterally, with reduced horizontal separation, to correspond to the positions of the curved lane boundaries and vertically on the image to compensate for the difference between distances along a straight and curved path.

Another image enhancement is to alter the appearance of an object in a particular zone surrounding the vehicle in order to provide an indication, such as a warning, to the driver. As an example, a vehicle that is too close to the equipped vehicle for safe-lane change, may be displayed in a particular color, such as red, may flash, or otherwise be distinguishable from other images on the display. Preferably, the speed of the equipped vehicle **10**, which may be obtained from known speed transducers, may be provided as an input to the rearview vision system in order to cause such warning to be a function of the vehicle speed which, in turn, affects the safe separation distance of vehicles. The operation of the turn signal may also be used to activate such highlighting of other road users or to modify the scope of the image displayed. In order to determine the distance of objects behind vehicle **10**, a separate distance-measuring system may be used. Such separate system may include radar, ultrasonic sensing, infrared detection, and other known distance-measuring systems. Alternatively, stereoscopic distance-sensing capabilities of side image capture devices **14** may be utilized to determine the separation distance from trailing objects utilizing known techniques.

Thus, it is seen that the image displayed on display **20–20'''** may be different under different circumstances. Such different circumstances may relate to the vehicle's direction of travel, speed, rate of turn, separation from adjacent objects, and the like.

Various other forms of image processing may be utilized with rearview vision system **12–12'''**. Luminant and chrominant blending may be applied to the images captured by image capture devices **14, 16** in order to produce equality of the image data whereby the image portions appear as if they were produced by one image capture device. The dynamic range of the image capture devices may be extended in order to provide high quality images under all lighting conditions. Furthermore, individual pixel groups may be controlled in order to selectively compensate for bright or dark spots. For example, anti-blooming techniques may be applied for bright spots. Multiple exposure techniques may be applied to highlight dark areas. Image morphing and warping compensation techniques may additionally be applied. Resolution of the image capture devices and display may be selected in order to provide sufficient image quality for the particular application.

A heater may be applied to each image capture device in order to remove dew and frost that may collect on the optics of the device. Although, in the illustrative embodiment, the optical centerline of the camera coincides with the field of view, particular applications may result in the centerline of the camera pointing in a direction other than the centerline of the field of view. Although, in the illustrative embodiment, the image capture devices are fixed, it may be desirable to provide selective adjustability to the image capture devices or optical paths in particular applications. This is particularly desirable when the system is used on articulated vehicles where automated and coordinated camera aim may be utilized to maintain completeness of the synthesized image.

When operating the vehicle in the reverse direction, it may be desirable to provide additional data concerning the area surrounding the immediate rear of the vehicle. This may be accomplished by utilizing non-symmetrical optics for the center image capture device in order to provide a wide angle view at a lower portion of the field of view. Alternatively, a wide angle optical system could be utilized with the electronic system selectively correcting distortion of the captured image. Such system would provide a distortion-free image while obtaining more data, particularly in the area surrounding the back of the vehicle.

The invention additionally comprehends the use of more than three image capture devices. In addition to side image capture devices positioned at the front sides of the vehicle and a center image capture device positioned at the center rear of the vehicle, additional image capture devices may be useful at the rear corners of the vehicle in order to further eliminate blind spots. It may additionally be desirable to provide an additional center image capture device at a higher elevation in order to obtain data immediately behind the vehicle and thereby fill in the road surface detail immediately behind the vehicle. Such additional detail is particularly useful when operating the vehicle in the reverse direction. Of course, each of the image capture devices could be a combination of two or more image capture devices.

Although the present invention is illustrated as used in a rearview vision system, it may find utility in other applications. For example, the invention may be useful for providing security surveillance in an area where a building or other object obstructs the view of the area under surveillance. Additionally, the invention may find application in night-vision systems and the like. For example, the invention may be applied to forward-facing night-vision systems, or other vision enhancement systems such as may be used in adverse weather or atmospheric conditions such as fog, applied to provide an enhanced display of a synthesized image, which approximates a forward-facing view from a single virtual camera located rearwardly of the driver, taking advantage of the perspective features of the image.

Thus, it is seen that the present invention enhances the relationship between the driver's primary view and the image presented on the rearview vision system. This is accomplished in a manner which provides ease of interpretation while avoiding confusion so that the driver does not have to concentrate or look closely at the image. In this manner, information presented on the display is naturally assimilated. This is accomplished while reducing blind spots so that other vehicles or objects of interest to the driver will likely be displayed to the driver. Additionally, the use of perspective allows distances to be more accurately determined.

Changes and modifications in the specifically described embodiments can be carried out without departing from the principles of the invention, which is intended to be limited only by the scope of the appended claims, as interpreted according to the principles of patent law including the doctrine of equivalents.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A vehicular rearview vision system, comprising:

at least one image capture device positioned on the vehicle and adapted to capturing images of objects; and

a display system which displays an image which comprises a rearward facing view of objects captured by said at least one image capture device;

wherein said display system enhances the displayed image by including an image enhancement comprising a visual prompt perspectively related to objects in the

image displayed and which visually informs the driver of what is occurring in the area surrounding the vehicle including relative position of objects behind vehicle.

2. The rearview vision system for a vehicle in claim **1** wherein said image enhancement comprises a graphic overlay superimposed on the displayed image indicating distances of objects from the vehicle.

3. The rearview vision system of claim **2** wherein said graphic overlay comprises at least one horizontal mark superimposed on the displayed image.

4. The rearview vision system for a vehicle in claim **3** wherein said at least one horizontal mark is adjusted in response to vehicle speed.

5. The rearview vision system for a vehicle in claim **3** wherein said at least one horizontal mark comprises a plurality of short horizontal lines superimposed on the image at regular rearward intervals.

6. The rearview vision system for a vehicle in claim **5** wherein said lines are positioned to correspond to boundaries of the lane in which the vehicle is travelling.

7. The rearview vision system for a vehicle in claim **6** wherein said lines are moved laterally to correspond to positions of curved lane boundaries when the vehicle is turning.

8. The rearview vision system in claim **7** including a monitoring device for monitoring vehicles turning.

9. The rearview vision system in claim **8** wherein said monitoring device comprises one of a monitor of movement of the vehicle's steering system, a monitor of an output of an electronic compass, and a monitor of the vehicle's differential drive system.

10. The rearview vision system in claim **1** wherein said image is enhanced by a graphic overlay superimposed on the displayed image including indicia of the anticipated travel of the vehicle.

11. The rearview vision system in claim **10** wherein said graphic overlay is disabled when the vehicle's gear actuator is not in reverse gear.

12. The rearview vision system in claim **1** wherein said at least one image capture device comprises at least two image capture devices positioned on opposite lateral sides of said vehicle and wherein said display system displays an image synthesized from outputs of said image capture devices which approximates a rearward-facing substantially seamless panoramic view.

13. The rearview vision system in claim **12** wherein said display system includes a display surface for displaying said outputs of both said image capture devices.

14. The rearview vision system in claim **12** wherein each of said image capture devices is a CMOS imaging array.

15. The rearview vision system in claim **1** wherein said at least one image capture device comprises at least three image capture devices including at least two side image capture devices positioned on opposite lateral sides of said vehicle and at least one center image capture device laterally between said side image capture devices and wherein said display system displays an image synthesized from outputs of said image capture devices which approximates a rearward-facing substantially seamless panoramic view.

16. The rearview vision system in claim **15** wherein said at least three image capture devices are at substantially the same height.

17. The rearview vision system in claim **15** wherein said display system includes a display surface for displaying said outputs of both said image capture devices.

18. The rearview vision system in claim **15** wherein each of said image capture devices comprises a CMOS imaging array.

19. The rearview vision system in claim **1** wherein said at least one image capture device comprises a CMOS imaging array.

20. A vehicular rearview vision system, comprising:

at least one image capture device positioned on the vehicle and directed rearwardly with respect to the direction of travel of the vehicle; and

a display system which displays an image from said at least one image capture device;

wherein said display system enhances the displayed image by visually highlighting hazards in the area surrounding the vehicle, wherein said visually highlighting hazards comprises modifying the displayed images which include said hazards.

21. A rearview vision system for a vehicle, comprising:

at least one image capture device positioned on the vehicle and directed rearwardly with respect to the direction of travel of the vehicle; and

a display system which displays an image from said at least one image capture device;

wherein said display system enhances the displayed image by visually highlighting hazards in the area surrounding the vehicle, wherein said highlighting hazards includes at least one of displaying the hazard in a particular color and flashing the image of the hazard.

22. The rearview vision system in claim **20** wherein said hazards include objects too close to said vehicle for safe lane-change maneuver.

23. A rearview vision system in claim **21** wherein said highlighting hazards includes at least one of displaying the object too close to said vehicle in a particular color and flashing the image of the object too close to said vehicle.

24. The rearview vision system in claim **20** including a speed transducer which provides an input to said display system such that a determination that objects are too close to said vehicle is a function of vehicle speed.

25. The rearview vision system in claim **20** wherein said display system responds to activation of the vehicle turn signal to visually highlight objects too close to said vehicle.

26. The rearview vision system in claim **20** including a sensing system for sensing distance of objects from the vehicle.

27. The rearview vision system in claim **26** wherein said sensing system comprises one of radar, ultrasonic sensing and infrared detection.

28. The rearview vision system in claim **20** wherein said at least one image capture device comprises at least two image capture devices positioned on opposite lateral sides of said vehicle and wherein said display system displays an image synthesized from outputs of said image capture devices which approximates a rearward-facing substantially seamless panoramic view.

29. The rearview vision system in claim **28** wherein said at least two image capture devices include stereoscopic distance-sensing capabilities.

30. The rearview vision system in claim **28** wherein said display system includes a display surface for displaying said outputs of both said image capture devices.

31. The rearview vision system in claim **28** wherein each of said image capture devices is a CMOS imaging array.

32. The rearview vision system in claim **20** wherein said at least one image capture device comprises at least three image capture devices including at least two side image capture devices positioned on opposite lateral sides of said vehicle and at least one center image capture device laterally between said side image capture devices and wherein said

display system displays an image synthesized from outputs of said image capture devices which approximates a rearward-facing substantially seamless panoramic view.

33. The rearview vision system in claim **32** wherein said at least three image capture devices are at substantially the same height.

34. The rearview vision system in claim **32** wherein said display system includes a display surface for displaying said outputs of both said image capture devices.

35. The rearview vision system in claim **32** wherein each of said image capture devices is a CMOS imaging array.

36. A vehicular rearview vision system, comprising:

at least one image capture device positioned on the vehicle and directed rearwardly with respect to the direction of travel of the vehicle; and

a display system which displays an image from said at least one image capture device;

wherein said display system includes a graphic overlay superimposed on the displayed image indicating distances of objects from the vehicle and visually highlighting of images of objects too close to the vehicle for safe lane-change maneuver, wherein said visually highlighting comprises modifying the displayed images which include said objects too close to the vehicle.

37. A rearview vision system for a vehicle comprising:

at least one image capture device positioned on the vehicle and directed rearwardly with respect to the direction of travel of the vehicle; and

a display system which displays an image from said at least one image capture device;

wherein said display system includes a graphic overlay superimposed on the displayed image indicating distances of objects from the vehicle and visually highlighting of images of objects too close to the vehicle for safe lane-change maneuver, wherein said visually highlighting includes at least one of displaying the object too close to said vehicle in a particular color and flashing the image of the object too close to said vehicle.

38. The rearview vision system in claim **36** wherein said graphic overlay comprises at least one horizontal mark superimposed on the displayed image.

39. The rearview vision system in claim **36** including a monitoring device for monitoring vehicles turning.

40. The rearview vision system in claim **39** wherein said monitoring device comprises one of a monitor of movement of the vehicle's steering system, a monitor of an output of an electronic compass and a monitor of the vehicle's differential drive system.

41. The rearview vision system in claim **36** including a speed transducer wherein said graphic overlay is adjusted in response to vehicle speed and highlighting of objects too close to said vehicle is a function of vehicle speed.

42. The rearview vision system in claim **36** wherein said display system responds to activation of the vehicle turn signal to visually highlight objects too close to said vehicle.

43. The rearview vision system in claim **36** wherein said at least one image capture device comprises at least two image capture devices positioned on opposite lateral sides of said vehicle and wherein said display system displays an image synthesized from outputs of said image capture devices which approximates a rearward-facing substantially seamless panoramic view.

44. The rearview vision system in claim **43** wherein said display system includes a display surface for displaying said outputs of both said image capture devices.

45. The rearview vision system in claim **43** wherein each of said image capture devices is a CMOS imaging array.

46. The rearview vision system in claim **43** wherein said at least two image capture devices include stereoscopic distance-sensing capabilities.

47. The rearview vision system in claim **36** wherein said at least one image capture device comprises at least three image capture devices including at least two side image capture devices positioned on opposite lateral sides of said vehicle and at least one center image capture device laterally between said side image capture devices and wherein said display system displays an image synthesized from outputs of said image capture devices which approximates a rearward-facing substantially seamless panoramic view.

48. The rearview vision system in claim **47** wherein said at least three image capture devices are at substantially the same height.

49. The rearview vision system in claim **47** wherein said display system includes a display surface for displaying said outputs of both said image capture devices.

50. The rearview vision system in claim **47** wherein each of said image capture devices is a CMOS imaging array.

51. The rearview vision system in claim **37** including a sensing system for sensing distance of objects from the vehicle.

52. The rearview vision system in claim **51** wherein said sensing system comprises one of radar, ultrasonic sensing and infrared detection.

53. A vehicular vision system, comprising:

at least two image capture devices positioned on opposite lateral sides of said vehicle and adapted to capturing images of objects; and

a display system which displays an image of objects captured by said at least two image capture devices, wherein said display system displays an image synthesized from outputs of said image capture devices which approximates a substantially seamless panoramic view;

wherein said display system enhances the displayed image by including an image enhancement comprising a visual prompt perspectively related to objects in the image displayed and which visually informs the driver of what is occurring in the area surrounding the vehicle.

54. The vision system for a vehicle in claim **53** wherein said image enhancement comprises a graphic overlay superimposed on the displayed image indicating distances of objects from the vehicle.

55. The vision system of claim **54** wherein said graphic overlay comprises at least one horizontal mark superimposed on the displayed image.

56. The vision system for a vehicle in claim **55** wherein said at least one horizontal mark is adjusted in response to vehicle speed.

57. The vision system for a vehicle in claim **55** wherein said at least one horizontal mark comprises a plurality of short horizontal lines superimposed on the image at regular spacial intervals.

58. The vision system for a vehicle in claim **57** wherein said lines are positioned to correspond to boundaries of the lane in which the vehicle is travelling.

59. The vision system for a vehicle in claim **58** wherein said lines are moved laterally to correspond to positions of curved lane boundaries when the vehicle is turning.

60. The vision system in claim **59** including a monitoring device for monitoring vehicles turning.

61. The vision system in claim **60** wherein said monitoring device comprises one of a monitor of movement of the

vehicle's steering system, a monitor of an output of an electronic compass, and a monitor of the vehicle's differential drive system.

62. The rearview vision system in claim **53** wherein said display system includes a display surface for displaying said outputs of both said image capture devices.

63. The rearview vision system in claim **53** wherein each of said image capture devices is a CMOS imaging array.

64. The rearview vision system in claim **53** wherein said at least two image capture devices is a CMOS imaging array.

* * * * *

United States Court of Appeals
for the Federal Circuit
In re: Magna Electronics, Inc., 2014-1801

XIII. PROOF OF SERVICE

I, Robyn Cocho, being duly sworn according to law and being over the age of 18, upon my oath depose and say that:

Counsel Press was retained by GARDNER, LINN, BURKHART & FLORY, LLP, Attorneys for Appellant to print this document. I am an employee of Counsel Press.

On **November 7, 2014** counsel has authorized me to electronically file the foregoing **Brief of Appellant** with the Clerk of Court using the CM/ECF System, which will serve via e-mail notice of such filing to all counsel registered as CM/ECF users, including any of the following:

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Additionally, paper copies will be mailed to the above counsel at the time paper copies are sent to the Court.

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/s/ Robyn Cocho
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XIV. CERTIFICATE OF COMPLIANCE

1. This brief complies with the type-volume limitation of Federal Rule of Appellate Procedure 32(a)(7)(B).

__X__ The brief contains 9,932 words, excluding the parts of the brief exempted by Federal Rule of Appellate Procedure 32(a)(7)(B)(iii),or

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2. This brief complies with the typeface requirements of Federal Rule of Appellate Procedure 32(a)(5) and the type style requirements of Federal Rule of Appellate Procedure 32(a)(6).

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November 7, 2014

/s/Terence J. Linn
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